SHORT COMMUNICATION

Journal of Fundamentals of Renewable Energy and Applications

2020

Vol.10 No.7

Biogas Developments and Perspectives in Europe

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ABSTRACT

This paper presents a review of the turn of events and points of view of biogas in and its utilization for power, heat and in transport in the European Union (EU) and its Member States. Biogas creation has expanded in the EU, empowered by the sustainable power strategies, notwithstanding monetary, ecological and atmosphere benefits, to arrive at 18 billion m3 methane (654 PJ) in 2015, speaking to half of the worldwide biogas creation. The EU is the world chief in biogas power creation, with more than 10 GW introduced and various 17,400 biogas plants, in contrast with the worldwide biogas limit of 15 GW in 2015. In the EU, biogas conveyed 127 TJ of warmth and 61 TWh of power in 2015; about half of absolute biogas utilization in Europe was bound to warm age. Europe is the world's driving maker of biomethane for the utilization as a vehicle fuel or for infusion into the petroleum gas network, with 459 plants in 2015 creating 1.2 billion m3 and 340 plants taking care of into the gas network, with a limit of 1.5 million m3. Around 697 biomethane filling stations guaranteed the utilization 160 million m3 of biomethane as a transport fuel in 2015.

INTRODUCTION

Natural degradation of organic material results in the production of biogas by microorganisms under anaerobic conditions. Anaerobic digestion convert organic material into biogas, a renewable fuel that could be used to produce electricity, heat or as vehicle fuel. In recent years, Anaerobic Digestion (AD) of waste and residues from agriculture and industry, municipal organic waste, sewage sludge, etc. has become as one of the most attractive renewable energy pathway.

The energy and climate policies in the EU and the introduction of various support schemes for promoting the utilization of renewable resources have encouraged the development of biogas plants for energy production. Anaerobic digestion provides opportunities for biogas to be used for generating energy, such as electricity, heat and fuel with additional economic, environmental and climate benefits. In Europe, most of the modern anaerobic digestors provide electricity and heat in electricity only plants, heat only or Combined Heat and Power (CHP) plants. Biogas can be upgraded to biomethane and injected into natural gas network or use it in transport vehicles, with proper purification to remove trace gases such as H2S and water and CO_2.

In addition to economic benefits from energy and fuel generation, AD plants provide additional environmental benefits (e.g. decrease in water, soil and air pollution, etc.). Traditionally, manure is directly used as fertiliser in agriculture, which could cause environmental problems, water contamination and pollution. Natural degradation of manure leads to emissions of methane and carbon dioxide during storage [1-3]. Anaerobic digestion contributes to mitigate odours associated with manure storage and decomposition and removes pathogens that can pose significant risk to human and animal health. Digestate from biogas production can still be used as fertiliser, just like manure, having the same content of nutrients as manure. This brings additional economic benefits by reducing the use of chemical fertilizers in farms, and reduces nutrient runoff and avoids methane emissions [1-4]. The use of manure to produce biogas for energy generation displaces the use of fossil fuels and thus contributes to emission reductions of GHG emissions and other pollutants.

RENEWABLE ENERGY POLICIES IN THE EU

In the European Union (EU), the basis of a European Union policy on renewable energy was made in 1997 when the European Council and the European Parliament have adopted the “White Paper for a Community Strategy and Action Plan” and when the share of renewable energy was 6% of gross internal energy consumption [5]. In 2007, the European Commission proposed an integrated Energy and Climate Change package on the EU's commitment to change (Energy policy for Europe (COM(2007) 1 final) [6] and Limiting Global Climate Change to 2 degrees Celsius - The way ahead for 2020 and beyond (COM(2007) 2 final) [7]. This includes an EU commitment to achieve at least a 20% reduction of GHG emissions by 2020 compared to 1990 levels and a mandatory EU target of 20% renewable energy [8].

The Renewable Energy Directive (RED) 2009/28/EC on the promotion of renewable energy sources [9] requires the MS to increase the share of renewable energy to 20% of gross final energy consumption at EU level and a contribution of 10% of the renewable energy in the energy use in transport in each MS by 2020. The RED specifies national objectives and legally binding targets for the share of renewable energy. In addition, the Fuel Quality Directive (FQD) 2009/30/EC [10] sets a target of a 6% GHG emission reduction for fuels used in transport in 2020. The RED and FQD include criteria for sustainable biofuels and procedures for verifying that these criteria are met. The RED includes provisions to facilitate the development of renewable energy, such as detailed roadmaps and measures taken to reach the RES targets and develop energy infrastructure [8].

On a longer term, the European Union has established the ambitious goal of building a competitive low carbon economy in 2050 and to reach 80%-95% GHG emission reduction by 2050 (COM(2011) 112 final) [11]. The share of renewable energy could reach between 55% and 75% of gross final energy consumption in the European Union in 2050 (COM (2011) 885 final) [12]. The Energy Roadmap 2050 investigated possible pathways for a transition towards a decarbonisation of the energy system and the associated impacts, challenges and opportunities [8].

A bioeconomy strategy (COM(2012) 60) was set to develop an “innovative, resource efficient and competitive society that reconciles food security with the sustainable use of renewable resources for industrial purposes” [13]. The bio-based economy plays a key role, as part of a green economy, to replace fossil fuels on a large scale, not only for energy applications, but also for chemicals and materials applications [8].

BIOENERGY AND BIOGAS MARKETS

The use of renewable energy sources experienced a significant growth worldwide, providing 19.2% of global final energy consumption in 2014 [16]. The use of renewable energy has increased significantly in the European Union from 8.5% in 2005 to almost 17% in 2015 in the gross final energy consumption. The global primary energy supply from biomass has reached about 60 EJ in 2015, representing a share of the total global primary energy consumption of 10% and a share in the final energy consumption of 14%. The traditional use of biomass, primarily for cooking and heating, has an important contribution, accounting for about 9% of the global final energy consumption. The modern use of biomass is increasing rapidly, particularly across Asia. The bioenergy share in total global primary energy consumption has remained steady since before the year 2000, at around 10% [16].

Bioenergy is likely to keep its major role in the European Union as renewable energy source in the energy mix until 2020 with a share above 60% of renewable energy. Overall, the share of bioenergy in the final energy consumption is projected to increase from 5.0% in 2005 and 9.6% in 2015 to almost 12% in 2020 [8]. Most biogas production occurs in the United States and Europe, although other regions increasingly are deploying the technology as well. Global biogas production increased from 0.28 EJ in 2000 to 1.28 EJ in 2014, with a global volume of 59 billion m3 biogas (35 billion m3 methane equivalent) [19].

DISCUSSION AND CONCLUSIONS

Bioenergy production, as part of a bio-based economy, has the potential to contribute significantly to the development of a green, low carbon economy. Biogas production can significantly contribute to the development of rural areas and encourage creating new supply chains for biomass feedstock, especially based on the use of waste and residues from agriculture. The potential of biogas contribution to renewable energy generation with various waste and residues is significant, both in terms of energy supply and in terms of the GHG emission reduction potential. In particular, biogas production from various waste and residues has no sideeffects (such as land use/land use change, ILUC, food security, etc.) and provides the highest GHG emission reductions among many bioenergy supply chains. This paper shows that significant progress has been made worldwide on biogas production both in small scale household digestors in developing countries, as well as in larger scale, commercial electricity biogas plants. Europe is a leader in biogas production, with a large, increasing number of commercial biogas plants (more than 17,000 plants) installed and a total electricity capacity of over 10 GW, as compared to a global electricity capacity of 16 GW. Anaerobic digestion provides energy (electricity, heat or fuels) for local farm use or to external users, delivered through the electricity, district heating or natural gas grids. However, despite a high existing potential, biogas production is still low in many European countries and the potential largely unused.

Biogas market development has been favoured in several countries by positive policy framework conditions, programmes, administrative procedures and financial support (feed-in tariffs, investment support, etc.) mainly for electricity generated from biogas. The use of heat from biogas, especially the use of derived heat are still limited, although some heat is used for own purposes and internal processes. However, the commercial use of heat from biogas has generally increased as result of the need to improve the economics of biogas plants through additional income, and as result of heat use obligations or measures to promote the use of heat from CHP plants. Biogas upgrading and biomethane production offer new opportunities for the use of biogas and for the substitution of fossil fuels in transport sector, overcoming the limitations for the use of heat and for improving the economics of biogas plants.

Economics are the key determining factor affecting the development of biogas production. The use of heat has emerged as an opportunity to increase the income and thus the profitability of biogas plants. The use of upgraded biogas in transport applications has increased as result of the new opportunities for the use of biogas and benefited from various support schemes and programmes. Technological improvements in biogas upgrading technologies to biomethane could lead to lower energy intensity and improved cost performance that could make biomethane cost competitive with fossil fuel use in transport. Biomethane can play a high role in the future as energy carrier because it is flexible in use and it is storable, which makes it highly valuable for balancing the energy grids. Biomethane has been obtained almost exclusively using a biological process (anaerobic digestion) involving sewage sludge or agricultural and industrial waste.

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