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BİYOKÜTLEDEN ENERJİYE: TÜRKİYE VE DÜNYADA BİYOGAZ POTANSİYELİ

ÖZ

Sürdürülebilir refah düzeyi için en önemli gereksinimlerden birisi enerjidir. Dünyada enerjinin sağlanması ve sürekli artan enerji ihtiyacının gelecekte güvenle karşılanmasına yönelik çeşitli çalışmalar yapılmaktadır. Kömür ve petrol gibi konvansiyonel enerji kaynakların yeterli olmadığı ve bu kaynakların kullanılması durumunda dünyamızın geleceği için büyük riskler oluşturduğu bilinmektedir. Bu nedenle son yıllarda, enerji ihtiyacının yenilenebilir kaynaklardan karşılanması artık bir mecburiyettir. Bu çalışmada; Türkiye ve Dünyada, biyogaz alanında yapılan çalışmalar genel olarak tartışılmıştır. Biyogaz güç tesisleri, üretilen enerjinin kullanım alanı ve diğer enerji kaynaklarına dönüştürülmesi araştırılmıştır. Biyogaz üretiminin arttırılması Türkiye şartlarında oldukça mümkündür. Bu nedenle, hayvansan, bitkisel ve diğer atıkların daha hızlı ve etkin bir şekilde kullanımı gerekmektedir.

Anahtar kelimeler: Yenilenebilir enerji, biyokütle, biyogaz potansiyeli

BIOMASS TO ENERGY: THE POTENTIAL OF BIOGAS IN TURKEY AND WORLD

ABSTRACT

Energy is one of the most important requirements for sustainable prosperity. Various studies are carried out in order to provide energy in the world and to meet the ever-increasing energy need in the future with confidence. It is known that conventional energy sources such as coal and oil are not sufficient and in case of using these resources, they constitute big risks for the future of our world. Therefore, it is now an obligation to meet the energy needs from renewable sources in recent years. In this study, the biogas field studies in Turkey and world have been discussed in general. Biogas power plants, the use of energy and conversion to other energy sources have been investigated. Increasing the production of biogas is quite possible that conditions in Turkey. Therefore, animal, vegetable and other wastes need to be used more quickly and effectively.

Key words: Renewable energy, biomass, biogas potential

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INTRODUCTION

Nowadays, the existence and the continuity of renewable energy sources are no longer needed and become compulsory. One of the important reasons for this situation is the intensive consumption of fossil fuels and the formation of greenhouse gases. This situation is also a source of global warming, causing global climate problems and many environmental pollution. The main substances in greenhouse gases are carbon dioxide and methane gas. Apart from these, similar wastes such as sulfur, nitrous oxide, soot and ash also pollute the environment. Because of the negative effects of fossil fuels on the environment and human health, the search for clean energy should be implemented quickly and effectively (Yılmaz et al., 2017).

Within the context of energy and climate framework, the European Union (EU) has determined 20% of energy consumption from alternative energy sources by 2020. Therefore, EU countries have determined their energy consumption targets (Al-Mansour vd., 2014). Slovenia has set a mandatory energy consumption target of 25%, while Germany has announced that it will supply 80% of its energy from alternative energy sources by 2050. Furthermore, the EU aims to reduce greenhouse gas emissions by 80-95% under the climate and energy policy by 2050 (Özer, 2017). In order to achieve this goal, the utilization capacity of these energy sources should be improved all over the world. In this respect, it is thought that bioenerence will play an important role in terms of meeting energy demand and energy security, and can be used practically in power generation.

In Turkey, 86% of energy needs has been met from fossil sources. 73% of energy has been imported (Anonim, 2017d). Being dependent on foreign countries to meet the energy demand is an economic pressure factor. While the highest incentives are given to biomass and solar energy with the regulations in energy law, the lowest incentives are given to hydroelectric energy with wind energy (Anonim, 2017e).

Alternative energy sources not only in Turkey, for all countries of the world are regarded as key to the future life. One of these sources is biogas. It is possible to obtain solid, liquid, gas fuel by using physical and chemical methods from biomass.

Biogas technology, which provides environmental and health problems to be made harmless by subjecting organic wastes to certain stages and energy conversion of these wastes has an important place in alternative energy sources. Biomass, which is a sustainable energy source, will be one of the important energy sources contributing to the reduction of greenhouse gas emissions by providing energy supply and security except for the development of countries (Yokuş and Onurbaş Avcıoğlu, 2012; Özcan et al., 2015).

Biogas is obtained by bio-methanation processes in the presence of different microorganism groups in the anaerobic environment of organic materials. Biogas is colorless, flammable and its main components are methane and carbon dioxide. It also contains a small amount of hydrogen sulfide, nitrogen, oxygen and carbon monoxide; it is 20 % lighter than air, with a bright blue flame burning gas mixture (Anonim, 2018a).

It is known that methane gas is formed by the decomposition of organic wastes and bacteria are formed in decomposition. In countries where biogas applications are applied, organic wastes are processed in biogas plants and energy production is provided.

By evaluating these organic wastes, environmental problems such as soil, water pollution, odor problem will be prevented. In addition, the use of treated organic fertilizers from plants will increase soil quality and increase product yield (Tufaner and Yaşar, 2014). Several studies have been done to ensure the importance of biogas and the spread in the world and Turkey.

Aoki et al.(2006) investigated the biogas production of animal fertilizers in a thermophilic reactor of 60 m^3 and concluded that the produced biogas could be used for electricity production in a 15 kW generator in Japan (Aoki et al., 2006). Rao et al. (2010) reported the biogas potential of agricultural waste, animal manure and industrial wastes in India was 40.734 MM^3 / year and the energy value of biogas was 25.700 MW (Rao et al., 2010).

White et al., stated that biogas yields of the changes in the amount of raw materials were affected by 10-80% in the plants with 120 MW electricity generation capacity established in cattle farms in Ontario (White et al., 2011). Deniz et al. have determined the animal waste biogas potential of and electrical equivalent of Turkey (Deniz et al., 2011). Afazeli et al., found that the potential of biogas production from slaughterhouse waste of Iran was 54 million m^3 in 2011 (Afazeli et al., 2014).

Çağlayan and Koçer have determined the amount of biogas that corresponds to the amount of fertilizer from animal wastes in Muş. As a result, the biogas production amount was 728.102 m^3 / day (Çağlayan and Koçer, 2014). In their study, Eryilmaz et al. determined the biogas potential of Yozgat province consisting of animal wastes. In addition, the Central Anatolia region of Turkey and compared the biogas production potential consisting of general waste of animal origin (Eryılmaz et al., 2015).

Boyacı, determined the biogas potential from the amount of fertilizer from Kırşehir and its districts according to different fuel types. As a result, biogas production in Kırşehir increased the welfare of individuals who are engaged in agriculture and animal husbandry, while it also stated that it would benefit the economic development of the province (Boyacı, 2017). In their study, Şenol et al., Determined the amount of biogas produced from animal, agricultural etc. wastes of Ankara province. They evaluated each biogas production amount as m^3/day. As a result of the evaluation, they determined the amount of biogas as 277,348 m^3/day from animal waste, 38,493 m^3/day from agricultural waste and 160,380 m^3 / day from kitchen waste (Şenol et al., 2017). Biogas is an alternative fuel to natural gas and is used in many areas. Lighting, heating, engine fuel, turbine fuel, fuel cell as well as the use of chemical production, electrical energy and mechanical energy has been translated into use. The organic fertilizer produced in biogas production is used for different purposes (Koçer and Kurt, 2013). In this study, the current status of biogas energy potential in the world and Turkey, using areas has been researched and made a general assessment of biogas energy.

BIOGAS ENERGY IN THE WORLD

In the world, 80% of biogas plants are China, 10% are India, 10% are Nepal and Thailand. When the number of biogas plants obtained by animal manure in Europe is examined, Germany is the country with the highest production with 2200 facilities. Germany is followed by Italy with 70 facilities. The construction of biogas plants in Germany since 1993 has reached 2200 facilities today (Tuncer,2013).

In developing countries, biogas has been produced in small-scale household systems in order to provide cooking, lighting and fuel, while in the developed countries, biogas plants with large-scale, farm-based, commercial, electricity and heat production have been focused on.

As an alternative energy source, biogas support programs for reducing the consumption of firewood, preventing deforestation, reducing air pollution, improving soil fertility and also for the development of domestic biogas systems for people to cook using biogas are implemented. Countries such as China, Thailand, India, Nepal, Vietnam, Bangladesh, Sri Lanka and Pakistan have major programs for biogas production (Scarlat et al., 2018).

In 2014, China has approximately one hundred thousand biogas plants and 43 million residential scale systems. 15 Mm^3 of biogas from these plants corresponds to approximately 9 Gm^3 bio-methane. Within the scope of medium and long term development plan for renewable energy, it is aimed to reach 50 Gm^3 biogas production, 8000 biogas projects with 3000 MW power and 80 million home biogas system by 2020. The target biogas plant potential is estimated to be 200-250 Gm^3 per year (REN21, 2015; Jingming, 2014).

In India, the National Biogas and Fertilizer Management Program aims at the construction of domestic-sized biogas plants to produce fuel and organic fertilizers for cooking (Ministry of New and Renewable Energy, 2014). It plans to establish 110,000 biogas plants from 2014 to 2019. In 2015, the electricity power of the established facilities was 179 MW, while in 2016 it reached 187 MW (IRENA,2017). It is one of the countries with the most successful biogas programs in the world, with more than 330 thousand domestic biogas plants established within the scope of the Nepal Biogas Support Program and providing the fuel to be used in cooking (REN21, 2015).

The biogas program, which started in 2003 in Vietnam for the livestock sector, aims to develop commercial biogas plants and has contributed to reach 183,000 biogas plants at the end of 2014. The National Domestic Biogas and Fertilizer Program, which reached 36 thousand local biogas systems by the end of 2014, was starred in 2006 for the rural and non-network areas of Bangladesh in order to produce cooking gas. Bangladesh has a plan to build at least 130 commercial biogas systems with an average capacity of 50kW by 2017 and to build 100,000 small biogas plants by 2020. It started to operate over 6000 local biogas plants in Sri Lanka and 4,000 in Pakistan (Scarlat et al., 2018).

Despite the large amount of waste found in Africa, biogas production has backward compared to other regions. Biogas systems have still being established in Côte d'Ivoire, Ethiopia, Burkina Faso, Ghana, Guinea, Kenya, Nigeria, Rwanda, Senegal, South Africa, Uganda. National programs have currently being implemented in Rwanda, Tanzania, Kenya, Uganda, Ethiopia, Cameroon, and Myanmar (Austin and Morris, 2012).

In Africa, the Biogas Partnership Program (ABPP), supported by the Dutch Ministry of Foreign Affairs and the Dutch Development Agency, Ethiopia, Kenya, Tanzania, Uganda and Burkina Faso to build approximately 100,000 local biogas plants to supply energy to approximately 500,000 people in five African countries by 2017 has aimed at the development of national biogas programs. Around 16000 biogas plants have been installed in five countries (http://africabiogas.org/. ,2017). “The Biogas for Better Life” initiative aims to build two million domestic biogas systems by 2020. In this way, it is aimed to provide clean energy that 10 million people will use for cooking (Van Nes and Nhete, 2007).

BIOGAS POWER IN TURKEY

Working in the field of biogas production in Turkey started in the 1950s by the Institute of Soil and Water Research. In the 1960s, pilot facilities were established within the State Generation Farms, Eskişehir Soil Water Research Institute of the Ministry of Agriculture, 8 villages of Eskişehir and 8 biogas plants including Çorum testing station were established. Although some of the facilities yielded good results, the studies have ended because of lack of technical personnel and insufficient

training of farmers. Especially in the early 1980s with the oil crisis experienced worldwide, Rural Services Ankara Soil Water Research Institute in the creation of biogas units has increased the work done in Turkey.

After 1980, when UNICEF supported the production of biogas technically and economically, the first work by the State Planning Organization was realized with the establishment of a 35 m^3 facility in Muş. Then, with the support of the government, around 1000 facilities in different volumes were established. Studies in the field of biogas have been among the research projects that universities give importance to in the 2000s.

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Between Turkey and Germany in 2010, the protocol was signed in 1200 for the animal's grown in biogas production facility. In addition, it was found that the fertilizer produced as a result of biogas production was sufficient for the cultivation in the plant area.

In Turkey, there are eight (totally 129 m^3) in Kayseri, one (15m^3) in Konya, one (22m^3) in Gediz and one biogas plant operating in Elazığ with 280 m^3 volumes. In addition, the municipalities of Istanbul, Ankara, Adana, Bursa and Kayseri work on biogas production. It is planned that Kocaeli Metropolitan Municipality will generate 2 million kW of energy annually from the facility to be implemented with the support of four universities (Çağlayan and Koçer,2014;Eryılmaz et al,2015;Şenol et al, 2017).

Biogas plant established in 2014 in Beypazarı-Ankara, has produced 2.5 MW of electricity by using chicken manure. In 2016, there were agreements for the installation of a plant with 196.700 m^2 in Elmadağ-Ankara with production capacity of 6 MW. 800-1200 tons of vegetable and fruit waste, poultry and bovine fertilizers have been used daily.

According to 2017 data, there were 1347435 cattle, sheep and poultry in Kırşehir. 14855273 m^3/year biogas have been produced from animal waste, corresponding to approximately 69819781 kWh of electrical energy (Boyacı,2017). As of 2015, the amount of biogas from cattle, sheep and poultry in the Eastern Anatolia Region was 841.060.461 m^3 (Karakuzulu et al, 2017). The biogas potential of Eregli-Konya from animal and plant - food were 177,921,276 m^3 in 2016. This biogas can provide approximately 4.270.110 GJ of energy (Tunçez, 2018). The annual total amount of biogas originating from cattle, sheep and poultry in Çanakkale has been determined as 96.934.753 m^3 (Ilgar, 2016). Odayeri having the largest capacity in Turkey, landfill gas power-biogas plant is located in Istanbul. With an installed capacity of 33.81 MWe, it meets the needs of an average of 68.273 people. The annual average electricity production is 226 GWh and the ratio of the plant to installed power is 0.0416%. 1KWh electricity generated by the plant until 2020 will be purchased by the government for a value of $ 0.1330. Mamak-Ankara biogas plant is the largest capacity in 12 plants under construction in Turkey (www.enerjiatlasi.com, 2018). In Turkey, there are 82 units engaged in the production of biogas plants. In the plants having a total installed capacity of 467.37 MWe, approximately 2.277 GWh of electricity can be produced. These plants and installed electrical powers are given in Figure 1 (www.enerjiatlasi.com, 2019).

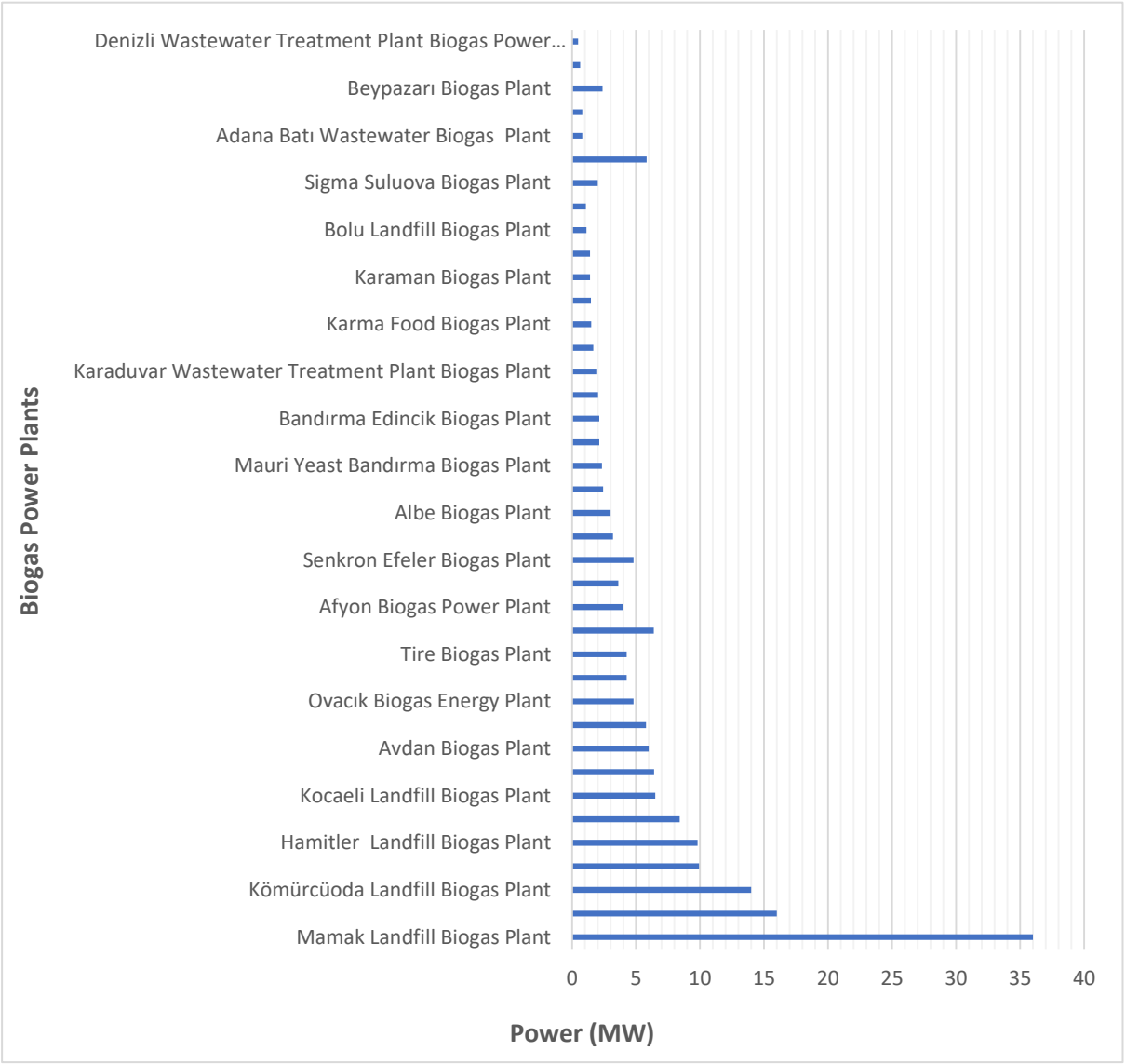

Figure 1. The biogas plants and their power in Turkey

CONCLUSION

Energy needs of developed and developing countries are constantly increasing. Given that fossil energy sources will be exhausted in the near future in the world and Turkey, non-polluting, reliable, clean, sustainable, environmentally friendly renewable energy sources; spreading the production and use of it is of great importance. In addition, accurate and efficient evaluation of renewable energy sources, rational energy strategies and policy implementation, ensuring energy supply security, and improving energy efficiency awareness in society are among the priorities in energy. Due to the high potential in terms of agriculture and animal husbandry in Turkey makes the biogas energy more importantly (Yılmaz at al,2017).

In Turkey, there are 82 biogas plants in which animal, agricultural, waste oil are sourced. The installed capacity of these plants is 378MW. For the year 2017, the total biomass power was 634 MW and the power generation was 2.796.6 GWh. Turkey's biomass target for 2023 is projected to be 1000MW. The total amount of agricultural waste is 15.336,035 tons and this value is equal to 303.2 PJ. (Koç et al., 2018). It is necessary to evaluate agricultural, animal and domestic wastes for energy needs and to solve environmental problems. In this way, both the economic input will be provided by the evaluation of organic wastes and the damage caused by the organic wastes to the environment will be prevented (Kumaş and Temiz, 2018).

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