



Municipal waste as biomass – renewable energy source

Piotr KARDASZ¹, Lech SITNIK¹, Marlena BENTKOWSKA¹, Maciej DWORACZYŃSKI¹, Miłosz DZIUBECKI¹, Aleksander GÓRNIAK¹,

¹ Politechnika Wroclawska, tel. + 48 71 3477918, piotr.kardasz@pwr.wroc.pl, lech.sitnik@pwr.wroc.pl, marlenabentkowska@pwr.wroc.pl, milosz.dziubecki@pwr.wroc.pl, maciej.dworaczynski@pwr.wroc.pl, aleksander.gorniak@pwr.wroc.pl,

Abstract

This article presents selected information on the use of biomass as an energy source. Biomass is a renewable resource, it can be obtained from, inter alia, selected municipal waste. The most popular methods of generating energy from biomass is its combustion or fermentation.

In Poland, the renewable energy sector is still small and should be developed because of the need to improve the condition of the environment and, at the same time, increasing demand for energy related to economic development. Energy from biomass is relatively unpopular. At the same time there is a problem of too big amount of waste that is not processed. Because of European Union regulations on the energetics and waste management it is required in Poland to adapt legislation in order to increase the share of renewable energy sources and to reduce the amount of waste landfilled. The solution may be energy production from biomass, derived from selected municipal waste.

Keywords: biomass, renewable energy sources, biogas, energy sector, waste, waste management

Streszczenie

Odpady komunalne jako biomasa - odnawialne źródło energii

Poniższy artykuł przedstawia wybrane informacje na temat wykorzystania biomasy jako źródła energii. Biomasa jest surowcem odnawialnym, może być pozyskiwana między innymi z wyselekcjonowanych odpadów komunalnych. Najpopularniejszymi metodami pozyskiwania energii z biomasy jest jej spalanie lub fermentacja.

W Polsce sektor odnawialnych źródeł energii jest wciąż niewielki, powinien być rozwijany ze względu na konieczność poprawy stanu środowiska naturalnego przy jednoczesnym, rosnącym zapotrzebowaniu na energię, związanym z rozwojem gospodarczym. Pozyskiwanie energii z biomasy jest stosunkowo mało popularne. Jednocześnie istnieje problem zbyt dużej ilości odpadów, które nie są poddawane przetworzeniu. Regulacje Unii Europejskiej w obszarze energetyki i gospodarki odpadami nakładają na Polskę obowiązek dostosowania prawodawstwa w celu zwiększenia udziału odnawialnych źródeł energii oraz zmniejszenia ilości odpadów, które trafiają na wysypiska. Rozwiązaniem może być pozyskiwanie energii z biomasy, pochodzącej z wyselekcjonowanych odpadów komunalnych.

Słowa kluczowe: biomasa, odnawialne źródła energii, biogaz, energetyka, odpady, gospodarka odpadami

1. Introduction

The development of renewable energy sector is inevitable during the ongoing environmental degradation, increasing energy demand and the depletion of conventional energy sources. Electricity is the basis for the country development and an essential part of everyday life. At the same time, an increasing production of waste is a serious environmental problem, which is caused mainly by the increase in consumption.

Traditional Polish energy industry is based on the combustion of fossil fuels, especially coal and lignite. The process produces numerous chemicals that are harmful to the environment and human health, especially carbon dioxide, nitrogen oxides and dust[1]. The demand for energy is increasing with the level of economic

development, it is therefore necessary to enlarge its production - but in such a way that will not increase the environmental hazard.

The renewable energy sources are wind, solar radiation, geothermal power, water and biogas and biomass[2]. Their use for energy production in Poland is low, but steadily increasing, as shown in Figure 1.1. The largest renewable energy resources in Poland include biomass and wind energy.

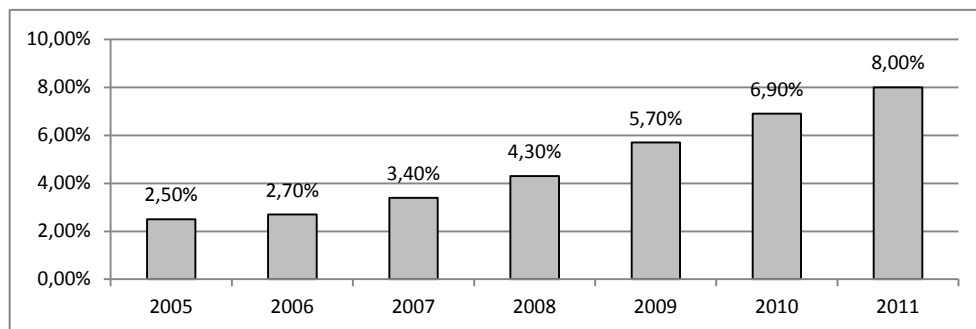


Fig. 1.1. The share of renewable energy in total electricity production in Poland[3]

2. The possibilities of using biomass as a renewable energy source

The increasing volume of waste requires solutions in the field of waste management, which means the re-use of it as a whole or in part. One of the methods of waste disposal is burning them, which reduce the amount of them, while providing in energy, that can be used. However, in the process of waste incineration there are serious air pollution produced. Therefore, only organic biodegradable material, as biomass, can be converted this way.

Sources of biomass can be divided into 3 groups[4]:

- energy plants, cultivated especially for use as a biomass, both to produce electrical energy (e.g. Miscanthus) and biofuel (e.g. rape);
- dry or wet waste, mainly from agricultural and food production (especially straw from cereal production);
- timber from forests industry (e.g. sawdust, tips of trees and branches and bark).

Biomass combustion is less polluting than conventional methods of energy obtaining, such as the burning of fossil fuels. It is also the most common way of producing energy from biomass - about 90% of global production takes place in the combustion process[5].

Another way of obtaining energy from biomass is the fermentation in the absence of oxygen, which results in biogas. Biogas consists mainly of methane and carbon dioxide[6]. Due to the methane content, the process should be done in a controlled environment. It also binds to the methane emission limit, which is beneficial for reducing the greenhouse effect. Biogas can be used as a source of electricity, heat, and as fuel for the engine propulsion. For the biogas production can be used vegetable waste, animal waste, sewage sludge or municipal waste[7].

In 2010 in Poland, about 17% of electricity from renewable energy sources came from biomass processing[8], which is shown on Figure 2.1.

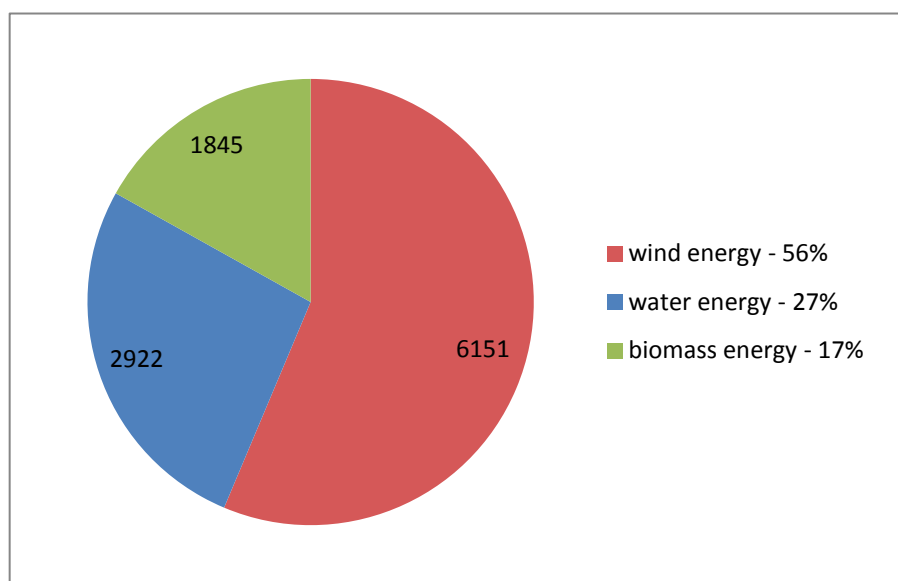


Fig. 2.1. Distribution of electricity from different types of renewable sources in 2010 [GWh][8]

3. Waste management in Poland

In 2009, Poland has generated almost 5% of total waste of the European Union. Per capita waste production was 316 kg, which is the lowest among the EU member states. For comparison, in Germany it was as high as 587, 547 in Spain, 540 in Italy, 535 in France and 526 in the UK[9] – the bigger amount of waste produced is due to a higher level of development of the countries and increased consumption.

The share of particular EU countries in waste generation is illustrated in Figure 3.1.

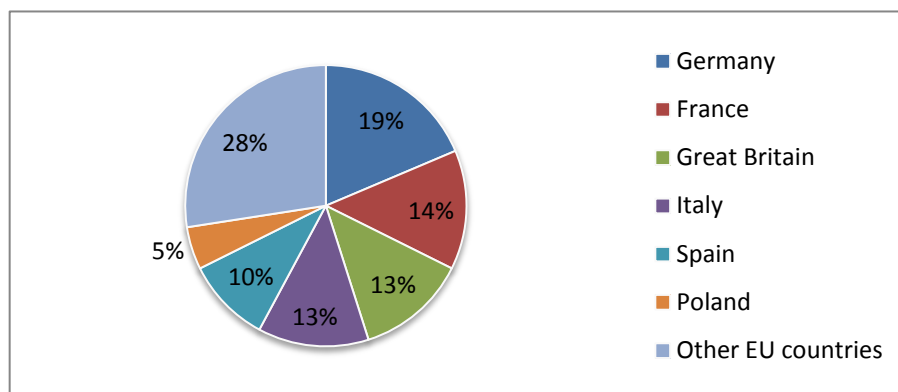


Fig. 3.1. Production of municipal waste in the EU in 2009[9]

However, in Poland there is a very big problem of illegal landfills. In 2011, the service took delivery of 9 827 600 tons of municipal waste, but, according to available data, total waste production was 12 128 800 tons[10]. It follows that about 20% of the waste were sent to landfills, dumps or incinerators which stays beyond the control of the government.

The waste management in Poland is gradually changing. In 2007, more than 90% of waste was landfilled, in 2009 it was less than 80%, in 2011 - 71%. However, the trend is clearly downward, which is a positive, but it is still too much waste being stored in Poland, in comparison with other European countries[9].

Figure 3.2 presents a comparison of municipal waste management methods in Sweden and in Poland in 2009. While in Poland almost 80% of waste was landfilled, in Sweden it was only 1.4%. The Swedes treat 98.5% of municipal waste they produce (by recycling, biological disposal or incineration), and in Poland it is not even 25%. Sweden is an example of effective and ecological waste management system.

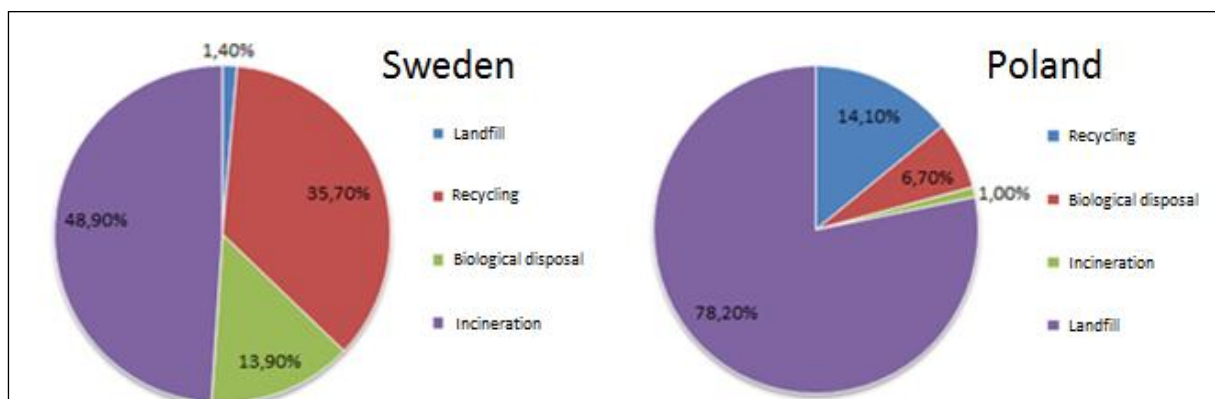


Fig. 3.2. Comparison of municipal waste management methods in Sweden and in Poland in 2009[9]

There is a correlation between the volume of waste and the level of economic development, which is why it is expected that in Poland the amount of waste produced will increase. Therefore, it is necessary to change the structure of methods of disposal, increase amount of waste recycled, incinerated and biologically disposed.

4. Polish and European legislation on waste management and renewable energy

In Poland, the waste management sector is governed by several laws. These are the Act of 14 December 2012 on waste (Dz.U. 2013 poz. 21), Act of 11 May 2001 on packaging and packaging waste (Dz.U. 2001 nr 63 poz. 638, with further amendments) and the Act of 1 July 2011, changing former act on maintaining cleanness and tidiness in municipalities (Dz.U. 2011 nr 152 poz. 897, with further amendments). These Acts adjust Polish law to EU standards, regulate in detail the principles of waste disposal and assign the responsibility for waste management.

The first mentioned, recently introduced, sets the fees payable to the municipality in purpose to manage waste. The fee may be constant, dependent on the number of people living in a household or other factors indicated by the local government. This regulation is controversial because of diversity of amounts of fees in different municipalities. The Act also obligates entities involved in the waste management business to register.

The last Act imposes into municipalities a duty to reduce by 2020 the amount of biodegradable waste which goes to landfill to 35% of the total amount of waste in 1995[11].

These acts are largely a national implementation of EU directives on waste management. The most important of these directives are:

- European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste
- Council Directive 99/31/EC of 26 April 1999 on the landfill of waste
- European Parliament and Council Directive 2000/76/EC of 4 December 2000 on the incineration of waste
- European Parliament and Council Directive 2008/98/EC of 19 November 2008 on waste and repealing certain Directives (also called Waste Framework Directive)

The latter directive unified earlier legislation and established a hierarchy of waste management principles[12]:

1. The amount of waste should be reduced;
2. The actions should be taken to re-use products;
3. Products should be re-used in recycling process, as intended or for other purposes;
4. The other actions should be taken to waste recovery, especially incineration, which produces electricity and heat;
5. Waste which could not be given to recovery must be disposed.

Significant act on renewable energy sources is the European Union climate and energy package, which implies to[13]:

- Reduce greenhouse gas emissions by at least 20% in 2020 (or 30% if global agreement for reduction of greenhouse gas emissions will be signed) as compared to 1990;
- Increase energy efficiency by 20% in 2020, compared to demand forecast for fuel and energy;
- Increase the share of renewable energy in total energy consumption to 20% in 2020, and increase the share of biofuels in total fuels to 10%.

This package raises a lot of public objections because of the very high costs of climate action during economic crisis (which are ineffective often), rising energy and fuel prices, as well as the transfer of manufacturing and jobs abroad to countries where is no such restriction in climate control[14].

Also important for this issue is the Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources. It sets the target level for renewables in energy production by 2020 for all Member States (for Polish 15%). It also provides increasing the protection of green spaces from over-exploitation, and using them for cultivation of energy crops and increasing the use of local raw materials in the energy industry[15].

Polish legislator has not implemented the Directive into domestic legal system yet. Therefore, the Commission took Poland to the EU Court of Justice[16].

5. Conclusions and prospects for development of waste-based energy sector

EU regulations impose duties on Member States, as reducing landfill waste and the emission of pollutants. Therefore it is inevitable to increase the share of biomass in energy production. The first action should be to regulate and harmonize Polish legislation with the European law.

Abroad, the development of technology of using waste as an energy source is much more intense. For example, in Larvik, Norway, fuel from selected and processed household waste is used in the local cellulose and paper industry. These kind of technologies are used in many Western European countries[17].

An obstacles to the development of similar projects in Poland, beside vague legal regulations, may be very high cost and long payback period, and also insufficient financial and information support.

According to The Institute for Renewable Energy in 2006, the most perspective renewable energy source in Poland is the biomass. The forecast for 2020 gives the same conclusion[18].

Conditions for the use of waste as an energy source will change with the improvements of legislation, economic development (which is associated with bigger demand on power, growing volume of waste, while increasing the level of investment), as well as with improvement of environmental awareness of Poles.

Countries like Sweden or Norway should be an examples of best waste management practice. The sector of renewable energy in Poland needs to be developed. The use of waste as biomass for energy production solves two problems: the problem of deficiency of renewable energy and the problem of too large amount of waste storage.

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