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Renewable sources of energy in farming

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Abstract

One of significant elements of balanced progress, bringing in considerable ecological and energetic effects, is making use of energy from renewable sources. The development and exploitation of renewable energy is the proper course of action in favour of respecting the energy from conventional sources, as well as increase in energetic efficiency. Farming, aside from its basic function of producing food, may also provide materials for producing electrical and thermal energy, as well as fuel. Such materials may not only be farming products, but also its by-products or waste. By using them to produce energy or fuel, we gain doubled profit – we reduce the problem of management of these products and the following environmental burden and we diminish the consumption of conventional sources.

Key words: Renewable energy, farming, farmstead

Introduction

Farming is an important sector of polish economy. It is proven most of all in the structure of utilization of the land and in the structure of employment. It plays the particular role in the social and economic development of the rural areas. Taking up almost half of the total territory of the country, farming sets the general functions and directions in the land's utilization and shapes the overall natural environment and the landscape. The cleanliness of waters, air and soil, as well as the diversity of the animals and plants' species all largely depend on farming. That is why it is important to employ innovation in the farming sector that will include the usage of renewable sources of energy through farming.

The characterization of the issue

Renewable sources of energy are "the sources of energy that do not use exhaustible natural resources and are being constantly replenished by the nature. Their biggest ecological advantage is the usage of natural processes and lack of pollution, and the economic advantage is lack of fuel costs or in case of biomass, the significant costs of transporting fuel on large distances." [Lucki, Misiak 2010].

Included as renewable energy medium are: solid biofuels, heat pumps, urban wastes, geothermal energy, liquid biofuels, biogas, wind energy, hydro energy and solar energy.

Usage of renewable energy is closely tied to the following factors: the diversity of the renewable sources, fixed unit cost of obtaining energy from these sources, minimal impact on the environment, a different intensity of renewable energy in every place, the lack of necessity of long-distance transport of energy due to its obtainment everywhere (Nowacki 2010).

The following chart (tab. no. 1) shows that the most important source of obtaining energy is the solid biofuel. The next important medium is the wind energy. It is the kinetic energy of wind that is used to produce electrical energy in the wind turbines.

Tab. no. 1. The contribution of renewable energy media in the overall obtainment of energy from renewable sources in the year 2013.

Energy Medium	**Solid biofuel**	**Solar energy**	**Hydro energy**	**Wind energy**	**Biogas**	**Liquid biofuel**	**Geothermal energy**	**Urban waste**	**Heat pumps**
[%]	80,03 %	0,18%	2,46%	6,05%	2,12%	8,20%	0,22%	0,42%	0,33%

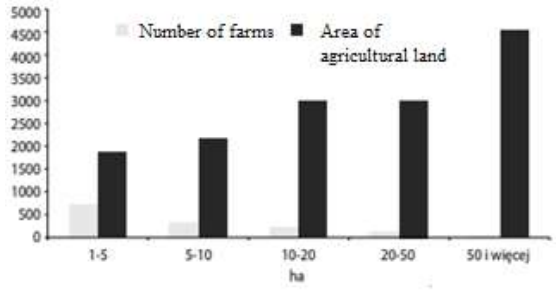
Source 1 Energy from renewable sources in 2013., GUS, Warszawa 2014, s. 29,

In Poland's Energy Policy until 2030, quantitative objectives for energy production from RES were set and a number of implementation measures were envisaged:

- increase in RES's share in final energy consumption from 7.2% in 2007 to 15% in 2020 and 20% in 2030;
- increase in the use of biofuels from 1% in 2005 to 10% in 2020;
- forest protection, promotion of energy crops;
- construction of at least one agricultural biogas plant in each commune;
- assistance for manufacturers of renewable energy equipment;
- maintaining a support system for energy production electricity from RES and the introduction of new support systems for heat from RES;
- creating conditions for the development of offshore wind farms;
- direct support for the construction of new generation installations and networks for RES (Skoczkowski and others 2016) .

Polish agriculture is characterized by high fragmentation - the average area of agricultural land (UAA) per one farm increases gradually and in 2014 amounted to 10.3 ha of arable land (w 2011 - 9.1 ha, a in 2002 - 5.8 ha). Despite some acceleration of concentration, slightly more than half of households in Poland (51%) uses no more than 5 ha of UAA. IN 12.7% of UAA is located on these farms. Almost 75% of households use less than 10 ha of UAA, a their combined participation in agricultural land is 27.7%. These farms from the rules lead to production using traditional methods, with low mineral fertilization and consumption of chemical plant protection products, also industrial feed in nutrition of farm animals, especially cattle. Next, almost 31% of arable land is located in 10-30-hectare farms. Over 72 thousand farms (5.2% of the total population) is characterized by the area of over 30 ha of UAA and it has a little over 6 million ha of UAA, i.e. 41.3% of arable land (Farm characteristic 2017).

Fig. 1 Number of farms and the area of agricultural land in Poland in 2016



Source 3 Characteristics of agricultural holdings in 2016 , Central Statistical Office, Warsaw, 2017.

The average total area of an agricultural holding was 11.51 ha and was comparable to the average of 2013 (11.54 ha). The average total area in farms with UA area above 1 ha in 2016 was 11.67 ha (in 2013 - 11.79 ha) (Farm characteristics 2017).

As of 31 December 2016, 15.3 million people lived in rural areas. The median age of men living in the countryside in 2016 was 37.4 and compared to 2006 was 3.5 years higher. Men living in the countryside were on average 2 years younger than men from cities. Also the inhabitants of the village were younger than the inhabitants of the cities. The median age of women living in the countryside in 2016 was 39.5 years, while women living in cities 43.5 years. As in the case of men, the average age of inhabitants of the village also increased in relation to 2006 (by 3 years). (Rural areas 2017).

The processes of modernization and specialization of farms, as well as concentration of production, are becoming more visible, especially in regions with good production conditions. At the same time, unprofitable small farms are liquidated, in which extensification of production, most often conducted only for the needs of the household, and even its complete abandonment is observed (Characteristics of farms 2017).

Modern agriculture and farms need more and more energy. Currently, farmers in Poland consume 6% of the total energy balance (Effectiveness of use 2010). In addition, agriculture is a privileged sector in the field of the use of renewable energy sources, each farm has many opportunities to produce energy from renewable sources (i.e. sun, water, wind). The use of a single source of renewable energy reduces living costs and production costs on farms, it is a source of additional income from the sale of surplus energy, as well as a way to protect the environment. These benefits are multiplied if individual RESs so far function in local integrated systems.

According to Professor Z. Wójcicki , in order to meet the requirements related to climate policy and the 3 x 20% package, the use of renewable energy in agriculture should increase in Poland from around 50 PJ in 2005 (about 20% of total RES energy production in Poland) to 85 PJ in 2030, with a rapid increase in demand for electricity, especially in agricultural households (increase in energy demand by almost 50% compared to 2005). With the increase in electricity consumption in Poland, about 90% in coal-fired power plants, agriculture contributes to a proportionately higher CO2 emissions due to much higher (up to 15%) of total losses in transmission and distribution of energy and the length and poor condition of rural networks

transmission. The author also draws attention to the need for an extremely rapid increase in the use of new renewable energy technologies in the country, such as wind farms, biogas plants and solar collectors, whose share in 2030 is expected to achieve more than 40% of total energy consumption from renewable energy in agriculture, and highlights the high emissivity and additionally low emission related to the final use of solid fuels in the countryside, especially coal and traditional biomass (Wójcicki 2007).

The calculations of the issue of the agricultural sector in the project "Impact of renewable energy on European farmers", developed for the European Commission, shows that the development of renewable energy in rural areas in the EU with particular focus on the agricultural sector will contribute to reducing CO2 emissions by more than 230 Mton CO2e , of which the highest indicator of reduction of a greenhouse gas unit in relation to the generated energy is wind energy and biogas, followed by solar thermal energy (OZERISE 2013).

Agriculture has the largest of all sectors of the economy and, as before, in the only negligible use of RES potential, in particular solar energy and wind. In our climatic conditions, with annual amounts of solar radiation at the level of 1000 kWh / m2 (3,600 TJ / km2), from 1 km2 for RES energy production you can get respectively: 1440 TJ from solar thermal energy (40% solar collectors) , 360 TJ from photovoltaic solar energy (efficiency of 10%) and up to 70 TJ from wind energy (at high windmill density - 8 MW / km2) and up to 15 TJ from biomass (at the most efficient energy plants) (Wiśniewski 2016).

Biomass

Biomass is the oldest and most widespread renewable energy source . It is an organic substance that occurs naturally in the environment and formed as a result of the photosynthesis process. It includes solid or liquid vegetable or animal origin are biodegradable derived products, waste residues from agriculture and forestry, as well as industrial processes these products and part of the remaining wast are biodegradable. Biomass of vegetable or animal origin, we can be converted into biofuels, biogas or used directly for combustion. We can use agricultural by-products (e.g. straw, other parts of plants not processed for food or feed, surplus grasses, poultry farms, slurry, and slaughter waste) instead of purposeful cultivation of energy crops. The main advantage of biomass, as well as energy raw material in relation to fossil fuels, is a significant reduction of CO2 emissions to the atmosphere. Agriculture in Poland is to be main producer of biomass for energy purposes, while the use of forest biomass will be gradually reduced (Ginalski 2013).

The high energy potential of biomass creates an opportunity for climate protection, provided that it is used rationally. Improper biomass production can have a negative impact on nature and climate. Introduction of monocultures of energy plants, especially those grown without properly conducted cultivation treatments and with excessive fertilization, can lead to increased water and wind erosion, as well as to ground and surface water pollution. Therefore, the use of biomass for energy purposes should be preceded by a thorough analysis of the environmental, social and economic effects of renewable energy from this source. Agricultural energy raw materials should be produced under conditions of economic management of resources, and their production must not pose a threat to the environment (Banaszczuk et al., 2015) .

Biogas

Biogas is obtained in the process of anaerobic digestion of biomass. Biogas is a mixture consisting mainly of methane and carbon dioxide, produced by microorganisms from the decomposition of organic substances under anaerobic conditions. The biogas formed consists of 50-75% of methane and 25-45% of carbon dioxide, as well as small amounts of hydrogen sulphide, nitrogen, oxygen and hydrogen. The percentage of methane in biogas is the fuel value of this fuel. The greater its share, the higher the calorific value of biogas (Curkowski et al. 2009).

Agricultural biogas plants play an increasingly important role in the production of electricity from RES in Poland. Their number is increasing, especially in places where agricultural biogas plants are already operating, in northern, north-western and south-western Poland. In addition to large agricultural biogas plants, projects are planned for small installations, which implement one of two options (along with a small hydro energy) for the development of small-scale renewable energy installations in Poland (Chodkowska-Miszczuk 2014) . One of the reasons for the growing interest in small biogas plants is the fact that the use of biogas as RES in relation to small scale projects has a positive reception by the local society (Ebenezer et al., 2007).

The production of biomass in agriculture for energy purposes is a competition for food production due to the reduced area of crops intended for food and livestock for animals. The problem of such competition does not occur in the case of biogas, as long as it is produced from by-products of farming, unfit for consumption or not used for other purposes, and not from energy crops. It is also not a reason to reduce food production as a result of lowering the soil fertility caused by reducing the amount of organic matter returning to the soil in the case of burning of vegetable by-products (e.g. straw) and, as a consequence, lower yield of arable crops . A by-product in the production of biogas is fertilizer with an improved value in comparison

with the raw materials from which it was made. Biogas production in agriculture allows better use of existing resources on farms. On farms where livestock is kept, animal fodder is the basic raw material for biogas production. They can be supplemented with plant by-products and organic waste from households (Pawlak 2013).

Wind energy

Electricity that can be obtained from wind energy is charged to green energy, since its formation is not related to the combustion of any fuel. Agricultural areas are often wind farms. Their power varies in a range from a few to several hundred MW. And they usually belong to the farmers, k tors mainly engaged in Wield Awa land for wind turbines. It does not cause them much difficulty, as they can still lead both plant and animal production. On farms, small turbines with a capacity not exceeding 100 kW are usually used, commonly called small wind farms (MEW). First of all, turbines with power from 5 to 20 kW are used. These turbines should be often used in the country due to favorable wind conditions (4-5,5 m / s). In this respect, the best area is central and southern Poland (Proszak-Miąsik and Boryło 2014).

Solar energy

Solar energy is available to every person living on Earth and what is the most important is free, it is enough to use it properly . As you know, tell de Farm setting an agritourism or cannot functioning without hot water. It's a big convenience to get it without having to start a fire in a coal furnace. This can be obtained with the use of solar collectors, which are able to convert solar energy into thermal energy available almost all year round (Proszak_Miąsik and Boryło 2014) . In agricultural production, solar collectors can be used in drying agricultural products, vegetable production under covers (heating water to ground heating and plant irrigation (Pabis 2011).

In Poland, the largest number of independent investors use solar collectors to prepare domestic hot water for their own needs, and less frequently for agricultural or industrial production. According to IEO research in the country (in 2011 Poland was the fourth largest market in the EU), more than 1 million m 2 of solar collectors (more than 700 MW thermal power) have been installed (Więcka 2012). It can be estimated that solar water heating systems installed in Poland in over 100,000. households, of which a large part is the farms of farmers. Such a great interest in this type of installation is connected with the possibility of using EU funding.

Summary

One of the main challenges of the modern world, strongly noted in the EU politics, is the protection of the environment and countering the climate changes. The development of renewable energy usage and gradual reduction of fossil fuel usage are the condition to reduce the CO2 emission, which lead to halting changes to the atmosphere and in effect – the climate. The development of the renewable energy also means independence from the imported fuels for the economy of EU and Poland.

Farming, aside from its basic function of producing food, may also provide materials for producing electrical and thermal energy, as well as fuel. Such materials may not only be farming products, but also its by-products or waste. By using them to produce energy or fuel, we gain doubled profit – we reduce the problem of management of these products and the following environmental burden and we diminish the consumption of conventional sources. If the renewable energy sector will be well integrated in the farming, it may result in the significant profits for the farmers and the society on the European level.

To summarize, investing in renewable energy must not be accounted solely on its monetary profits. Energy, as well as resources and knowledge, is scarce, and the usage of biomass, wind and solar energy must not be treated as the production race for quantity and price, and in the overall calculations one must pay attention to accumulated environmental effects, which consist of energetic balance, CO2 balance, biological diversity and landscape, as well as social effects.

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