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PRODUCTION OF ELECTRIC ENERGY FROM RENEWABLE ENERGY SOURCES IN THE NATIONAL POWER SYSTEM

Key words

National Power System, Renewable Energy Sources, Electric Energy, Gross Energy Consumption.

Abstract

This publication contains national balances and statistical data concerning the amount and power of renewable energy sources, as well as information about the volume of electric energy production obtained from sources in National Power System.

Introduction

Poland should become energetically safe within the next 20 years. Such assumptions were adopted in 2009 by Polish Government in a document "Polityka Energetyczna Polski do 2030". This document includes a long-term strategy of development of energy sector, forecast of demand for fuels and energy. "Polityka Energetyczna" defines a few basic directions for the

development of Polish power industry. These directions include improving energy efficiency and the security of energy supplies, obtaining and producing fuels and energy, and the development of transmission and manufacturing infrastructure. Another goal is to limit the impact of power industry on environment through the rapid development of using renewable energy sources [2], [3], [8].

One of the activities of Polish Government within the scope of the development strategy of the Polish power industry is the act on renewable energy sources passed by the Polish Parliament on February 20, 2015. The act entered into force after the lapse of 30 days as of the date of submission. Some regulations concerning new forms of support of producers of from renewable energy sources have been binding since January 1, 2016. [4].

In this article, the authors focused on the level of the use of renewable energy sources for electric energy production in National Power System.

1. Energy reached by power plants in national power system that use renewable sources in the years 2010–2014

Total power used by manufacturing equipment using renewable energy carriers has increased in the years 2010–2014. According to Energy Regulatory Office, in the last year, the potential of renewable energy sources in Poland increased by 941.4 MW – to the level of 7000 MW. In 2014, the potential of OZE (renewable energy sources) increased by 517.9 MW, a year earlier by 1020 MW, and in 2012 – by 1078 MW. Last year's increase of the potential of OZE results mainly from powers in the wind energy industry. According to data of Energy Regulatory Office, power produced by wind power plants increased from 3836 MW to 4592 MW in 2015. However, the result at the end of 2015, announced by Energy Regulatory Office, is much lower than the estimates of the Polish Wind Energy Association, which estimates that the total potential of wind farms in Poland exceeds now 5000 MW. In the last year, the potential of biomass power plants has also increased from 1008.2 MW to 1122.6 MW.

In 2011, the share of photovoltaic cells in electric energy production appeared for the first time, and their value of reachable power increased from 1 MW to 27 MW in the years 2011–2014. Passing the prosumer act will contribute to the increase of the share of photovoltaics in obtaining electrical energy. It is confirmed by the development of the solar power industry in 2014. According to Energy Regulatory Office, the total power of photovoltaic cells in Poland was over 71 MW at the end of 2015. The photovoltaic market in Poland is dynamically developing. Large interest in photovoltaics in the last four years was boosted by new act and numerous subsidizing programs. Many photovoltaics power plants are presently being built in Poland. It is estimated that over 100 MW photovoltaics power plants may soon operate in Poland [9], [10].

Despite such growth in the share of power generation by solar power plants, the highest growth occurred in wind energy, particularly in the years 2010–2014. An increase from 1108 MW to 3836 MW is the most spectacular achievement in Polish renewable energy industry.

There are also upward trends in power generated by biogas power plants. In 2013, this increase was 20.3% contributing to reaching the goal of 15% share of energy from renewable sources in final gross energy consumption. In the case of solar power plants, their potential increased in 2015 from 188.5 MW to 212.5 MW. The growth of the electrical power generation reachable by power plants in the National Power System that use energy from renewable sources in 2010–2014 is presented in Fig. 1 according to [1].

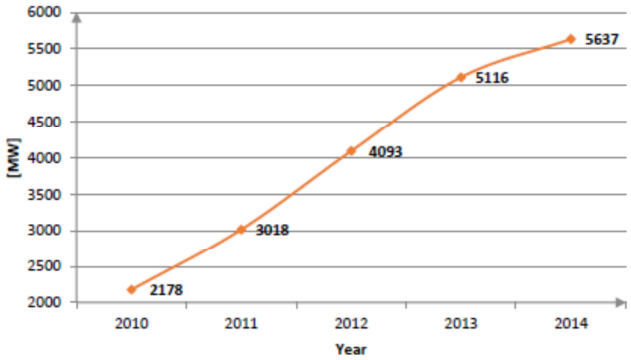

Fig. 1. Reachable electrical power generation of power plants using energy from renewable sources in 2010–2014

2. Production of electric energy from renewable energy sources

In accordance with the directive 2009/28/WE, member states are obliged to ensure a specific share of energy from renewable sources in final gross energy consumption. In 2020, obligatory national goals assume that the share of this energy in particular EU countries will be about 20% [11]. The share of discussed energy is calculated as a value of final gross energy consumption from renewable sources divided by value of final gross energy consumption from all sources, and it is expressed in percentages, that is, energy calculated with losses and balance differences [5], [6].

For Poland, this goal was defined as 15%. Moreover, each member state met the requirement that the share of energy from renewable sources in all types of transport in 2020 will be at least 10% of final energy consumption in transport [11], [12].

In order to meet these requirements, it is important to meet the 15% criterion. In the years 2010–2014, electric energy production from renewable energy carriers was systematically increasing. The share of particular carriers in

the production of this energy has also changed. Figures 2 and 3 present the changes that took place in the share of renewable energy carriers in electric energy production in Poland in the years 2010–2014.

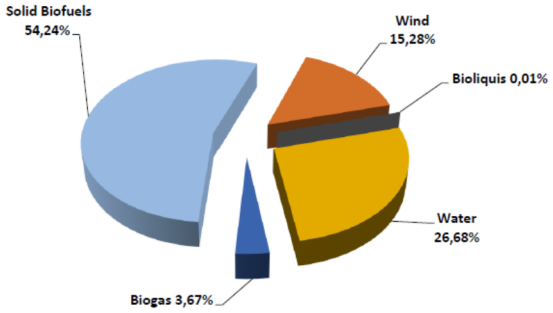

Fig. 2. The share of renewable energy carriers in electric energy production in 2010

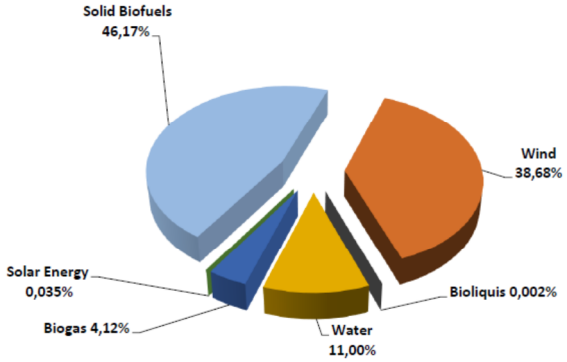

Fig. 3. The share of renewable energy carriers in electric energy production in 2014

Analysing the share of renewable energy carriers in OZE structure, the share of wind energy and biogas has increased, whereas, the share of water energy and solid biofuels has decreased. In recent years, electric energy production from photovoltaic cells has also increased, and this trend is expected to continue into the future. The share of electric energy produced from renewable energy sources of national gross electric energy consumption in the years 2010–2014 is presented in Fig. 4.

According to the report of National Power System for the year 2014, total electric energy production from all energy sources operating in National Power System for this year was 156 567 GWh. In the years 2010–2014, the share of electric energy generated in wind power plants dynamically increased. A high level of electric energy production was maintained in both electrical power

plants and heat power plants burning solid biofuels. Electric energy production in these facilities was 55.1% higher in 2014 than in 2010. The systems using biogas for the production of electric energy increased their production. In 2014, twice as much energy was produced than in 2010. Biogas had a particular impact on this growth. The production of electric energy has decreased in hydro power plants and the downward trend has continued since 2010 with a decrease of 25.3% from 2010 to 2014.

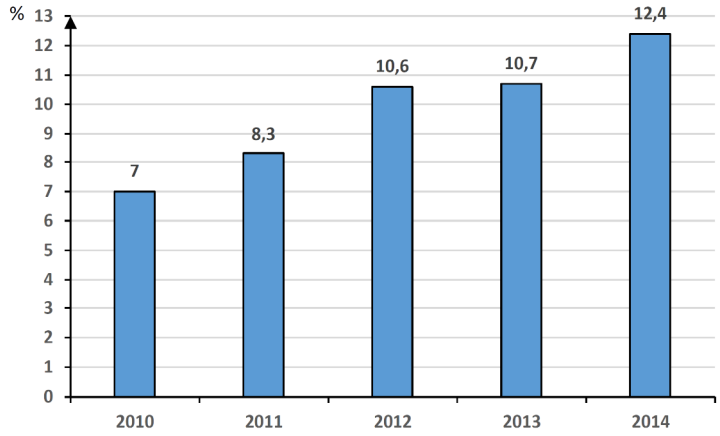

Fig. 4. The share of electric energy from renewable energy sources of national gross electric energy consumption in the years 2010–2014

3. The share of energy from renewable sources in final gross energy consumption

The report on reaching goals within the scope of renewable energy by the year 2020 published by European Commission showed that the European Union is on the right path to reach its goal of 20 per cent within the scope of renewable energy [7]. If we take into consideration that the estimated share of renewable energy in final gross energy consumption was 15.3 per cent in 2014, the European Union and most of the member states have made clear progress in reaching this level.

European Commission published these results in the report on progress in reaching goals by 2020. These goals included the legally binding EU goal of 20 per cent share of energy from renewable sources, the goal of 10 per cent share of energy from renewable sources in transport and binding national goals. The directive on renewable energy has been effective, because the development of renewable energy sources has accomplished the following:

– Total emissions of carbon dioxide were reduced by about 326 Mt in 2012 and by about 388 Mt in 2013.

– The demands for solid fuels in the European Union decreased by 116 Mt in 2013.

When it comes to the security of energy supplies in the European Union the following has been accomplished:

– Replacing natural gas with renewable energy was responsible for about 30 per cent of general emissions of fossil fuels that were avoided in 2013.
– Almost half of the member states decreased their national gross energy consumption from natural gas by at least 7 per cent.

Moreover, the report showed that more and more people accept renewable energy as an energy source and that 2020 goals are a driving force for global investments in renewable energy sources and supporting energy strategies.

The share of energy from renewable sources is calculated as a value of final gross energy consumption from renewable sources quotient value of final gross energy consumption from all sources and it is expressed in percentage terms.

A list of realization targets of the share of energy in 28 EU countries and Poland was drawn up as a result of analysis, which concerned the fulfilment of provisions of 2009/28/WE directive.

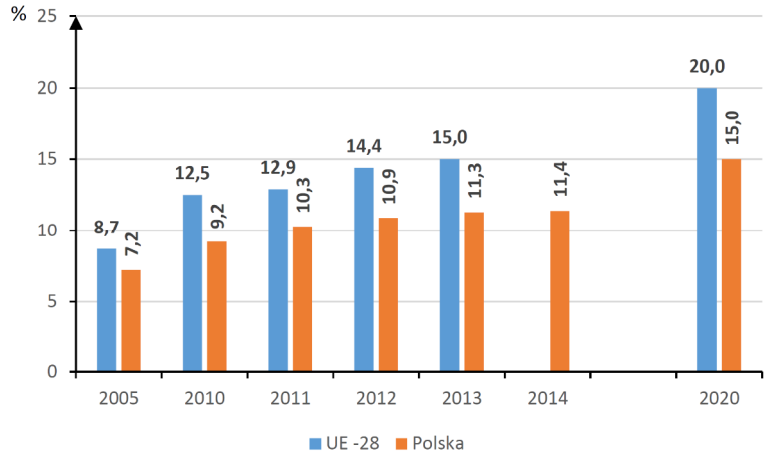

Fig. 5. The share of energy from renewable sources in final gross energy consumption in 2005, 2010–2014 acc. to [4]

The rate of the share of energy from renewable sources in final gross energy consumption in Poland was 11.45% in 2014. It increased by 4.25% in comparison to 2005. The average growth in 2010–2014 was 0.56 percentage points. In the last 4 years, it increased only by 1.15%, which is too slow, because it must increase by 3.55% in the next 5 years in order to realize the directive. Assuming that, in 2015, the rate is about 12%, it will be difficult to reach the remaining 3% by 2020.

In U-28, this share was 15% in 2013 and increased by 6.3 percentage points since 2005. The average growth in the years 2010–2013 was 0.8 percentage points. Assuming that it is about 16% in 2015 and maintaining this growth rate from the years 2010–2013, the European Union may realize a 20% rate of the share of energy from renewable sources in final gross energy consumption.

Summary

Statistical data concerning energy from renewable sources are presented in this article. The scope of presented data does give a full picture of the history obtaining and using energy from renewable sources in Poland. It results from considerable dispersion of sources of obtaining and the local character of its use. Small capacities of most of the facilities producing and using energy from renewable sources make it more difficult to include them in statistical research, and it also makes it more difficult to have comprehensive monitoring.

In Poland, many producers more and more often produce electric energy using renewable energy sources for their own needs. It is caused by more and more popular photovoltaics. It has an impact on a partial but small distortion of the level of value of energy generated from these sources.

The level of the development of the renewable energy industry in Poland is slow but consistent. Therefore, an appropriate state policy allowing the economy and the whole society to fully make use of potential of national resources of renewable energy plays a significant role. Highly developed and economically effective technologies of energy conversion should be applied to make all participants of this process fully satisfied. Therefore, further works on developing renewable energy industry in the national energy policy are necessary. The renewable energy industry may have a huge meaning for regional and local development. It may increase income of local governments, create new jobs and markets for companies manufacturing equipment for the production of electric energy.

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Wytwarzanie energii elektrycznej z odnawialnych źródeł energii w krajowym systemie elektroenergetycznym

Słowa kluczowe

Krajowy system elektroenergetyczny, odnawialne źródła energii, energia elektryczna, zużycie energii brutto.

Streszczenie

Publikacja zawiera krajowe bilanse i dane statystyczne dotyczące ilości i mocy odnawialnych źródeł energii, jak również informacje o wielkości produkcji energii elektrycznej uzyskanych ze źródeł pracujących w Krajowym Systemie Elektroenergetycznym.