

Transformations in renewable power generation in Wielkopolska Province, Poland, at the beginning of the 21st century¹Adam Mickiewicz University, Poznań²University of Environmental and Life Sciences in Wrocław, Wrocław
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Abstract. The goal of the work was to determine the changes occurring in the field of using renewable energy resources during the last ten years in Wielkopolska Province (Poland). The percentage of energy from renewable resources in the production and consumption of electrical power in Wielkopolska in 2005 did not exceed 1%. In each subsequent year there was a growth in the production and consumption share of electrical power, up to 7.8% in 2011. The annual average growth since 2005 amounted to approx. 1 percentage point for Poland and approx. 1.3 percentage point for the province. The current level of the share of renewable resource energy in electrical power generation in Wielkopolska Province, and on average in the whole country, is far below the strategic goal which Poland should attain by 2020 and below the average of EU states.

Keywords: renewable energy, the strategic goal, Midwestern Poland

Introduction

The development of renewable energy resources is considered to be an important element of not only environmental protection but also sustainable social and economic development [1, 2, 3]. A renewable energy resource is a resource which in the process of conversion uses energy of wind, sunlight, aerothermal and geothermal energy, waves, marine currents, sea (ocean) tides, the gradient of rivers (hydropower), energy from biomass, landfill gas and also biogas produced in the processes of wastewater discharge and treatment or decomposition of stored plant and animal waste [4]. In Poland by 2020 the percentage share of energy from renewable resources should amount to 15% of the total energy consumption [5, 6].

Electrical power in Wielkopolska Province (Fig. 1) is produced mainly by commercial power plants using fossil fuel combustion. The province, which constitutes 9.5% of Poland's area, generated from about 10% (2000) to 7.9% (2011) of the domestic production of electrical energy. In the recent years Wielkopolska Province has seen an intensive growth of renewable energy generation [7, 8, 9]. The goal of the work was to determine the changes occurring in the field of using renewable energy resources during the last ten years in Wielkopolska Province.



Fig. 1. Location of Wielkopolska Province (the dotted line) in Poland

Materials and Methods

The research used data from 2000-2011, coming from the yearbooks of the Central Statistical Office in Poland [10], the Statistical Office in Poznań [11, 12] and also the National Power System Report [13].

The data covered: the amount of generated power and its consumption, the amount of power generated from renewable resources in total and by particular types, the number and installed power for different types of renewable energy installations, in Wielkopolska Province and Poland. Due to the lack of a homogenous database, in some cases the analysis used the data from selected years of the investigated multi-annual period.

Changeability of the share of energy from renewable resources depending on year was determined with a simple linear regression equation. The coefficient of determination R^2 (%) served as a measure of the fit of the regression function to the empirical data.

For calculations, graphs and diagrams the study used Microsoft Excel 2010, charts were made with Microsoft Word 2010.

Results and discussion

The domestic generation of electrical power since 1990 has been slightly higher than its consumption [13]. The positive energy balance has remained until the present time and it is Wielkopolska Province that has a significant share in generating this surplus. In 2001-2011 the amount of generated electrical power in the province fluctuated from 12,640 GWh in 2010 to 14,730 GWh in 2003 (Fig. 2).

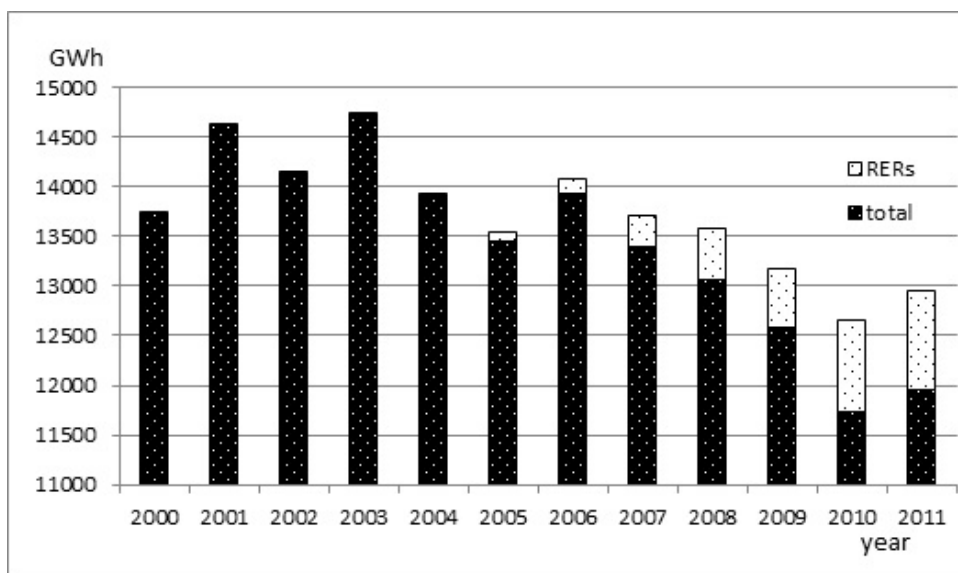


Fig. 2. Amount of electrical power production, including renewable energy resources (RERs), in Wielkopolska Province in 2000-2011

The percentage of energy from renewable resources in the production and consumption of electrical power in Wielkopolska, according to data from 2005, did not exceed 1% (Fig. 3).

In each subsequent year there was a growth in the production and consumption share of electrical power, up to 7.8% in 2011. The annual average growth since 2005 amounted to approx. 1 percentage point for Poland and approx. 1.3 percentage point for the province. The current level of the share of renewable resource energy in electrical power generation in Wielkopolska Province, and on average in the whole country, is far below the strategic goal which Poland should attain by 2020 and below the average of EU states [14, 15, 16]. For example, in the USA the share of RERs in electricity generation should grow to 25% by 2025 [3].

In the structure of power generation resources, one can notice a growth in power generation from wind and biomass, at the expense of a decreasing importance of water power (Fig. 4). In relation to the rest of Poland [8,10], Wielkopolska Province distinguishes itself by a big share of power generated from biomass, a relatively low share of energy from biomass and still a big share of water power.

In Wielkopolska the power of wind installations accounts for more than 90% of the total power of renewable energy installations (Fig. 5, Fig. 6), compared to an average of about 46% in Poland. Water and biogas power plants rank next in terms of power output. As for the share of the latter, it is similar to the Polish average.

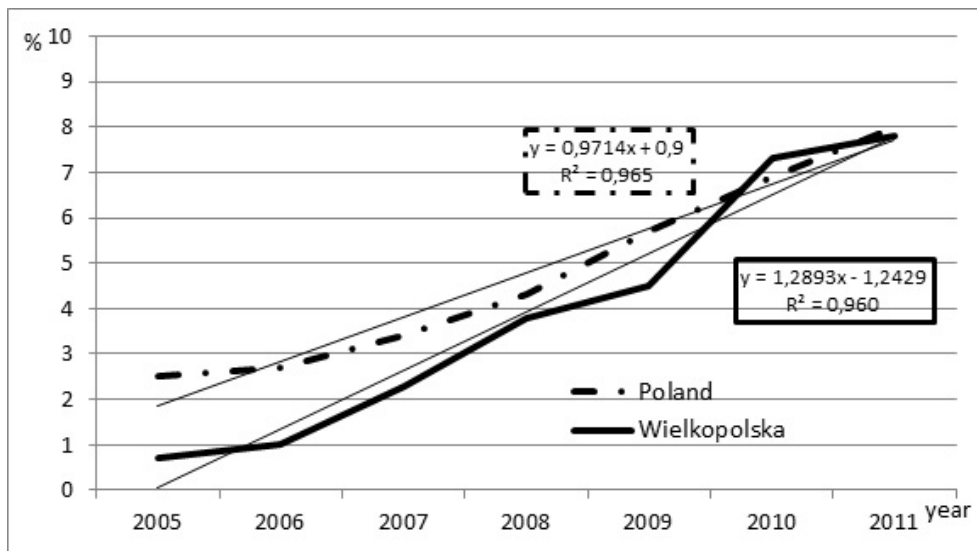


Fig. 3. Share of energy from renewable resources in the total electrical power production in Wielkopolska Province and Poland in 2005-2011

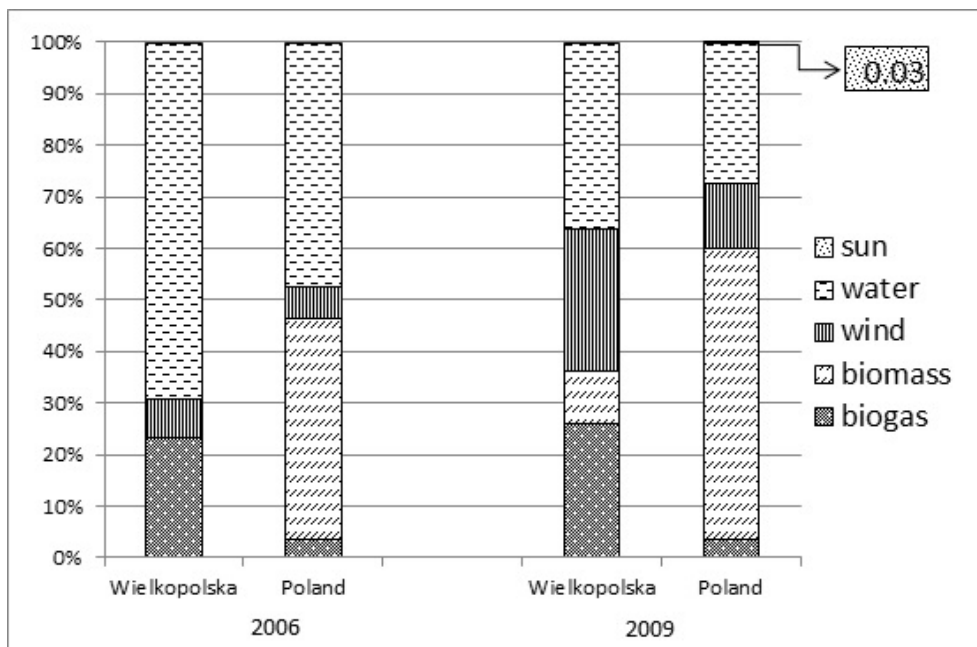


Fig. 4. Structure of renewable resources of power generation in Wielkopolska Province and in Poland in selected years

The level of energy from water power plants can be evaluated as low, much lower than the country's average. A very low share of utilising biomass results from the lack of data of its use in the process of co-combustion with other energy carriers by large commercial power or combined heat and power plants. First Polish investments in photovoltaic installations did not take place in Wielkopolska; so far in Poland electrical power from geothermal resources has not been generated.

Conclusions

1. Changes in using renewable energy resources in Wielkopolska were observed since the moment of Poland's accession to the EU. Since 2005 the annual average growth of the share of electrical power production from renewable energy resources increased by 1.3 percentage point and was larger than the average growth of this share for the whole country.
2. The share of renewable energy resources in electrical power generation in Wielkopolska is currently still low. To fulfill the EU requirements it will be necessary to build and connect to the power network much bigger renewable energy installations than operating at present.



Fig. 5. Distribution of wind farms in Wielkopolska Province in 2011 work on the basis of: <http://www.elektrownie-wiatrowe.org.pl/pl/energetyka-wiatrowa/lokalizator-farm-wiatrowych>

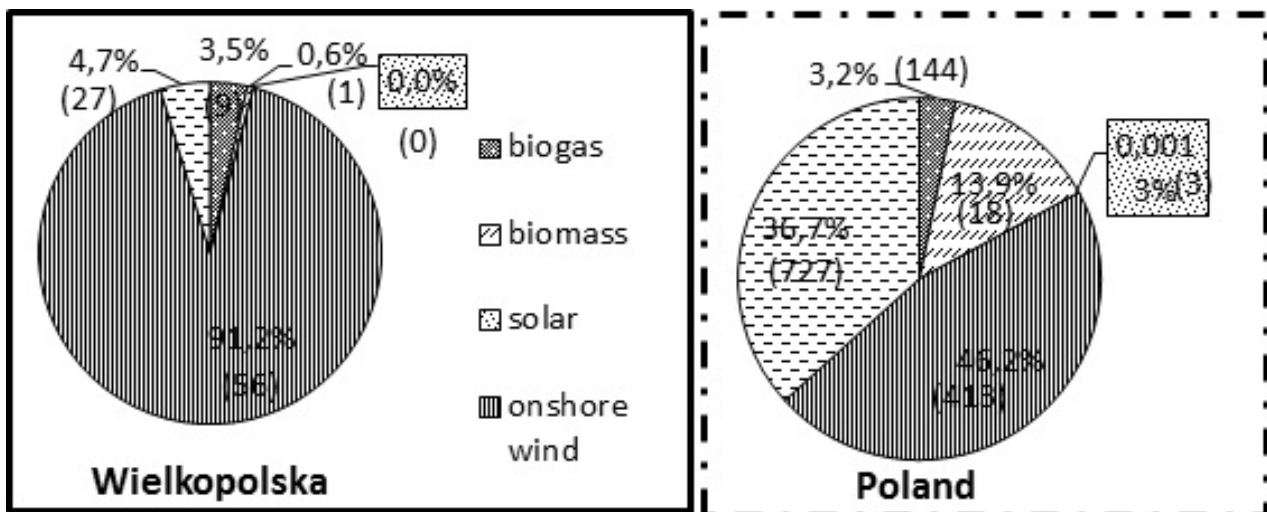


Fig. 6. Number (in brackets) and structure of power (in %) of various types of renewable energy installations in Wielkopolska Province in relation to Poland (as for January 2011) source: own work on the basis of [8] (for the cogeneration installation, the power cannot be determined)

3. Most power of renewable energy resources comes from investments in wind power generation, other sources of renewable energy do not arouse interest. It may show insufficient support for the development of this sector both in the region and in whole Poland.

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Аннотация. Е. Калбарчук, Р. Калбарчук. **Трансформация возобновляемых источников энергии в Великопольской провинции (Польша) в начале XXI века.** Целью исследования было определить изменения в использовании возобновляемых источников энергии на протяжении последнего десятилетия в области провинции Великопольской (Польша). Доля энергии из возобновляемых источников в производстве электроэнергии в исследуемой области, по данным 2005 года не превышает 1%. За каждый год сообщают об увеличении своей доли в производстве и потреблении электроэнергии, до 7,8% в 2011 году. Среднегодовой прирост с 2005 года составил около 1 процентный пункт для Польши и примерно на 1.3 процентного пункта в провинции. Нынешний уровень доли возобновляемых источников энергии в производстве электроэнергии в провинции Великопольской, как и в среднем по стране, по-прежнему намного ниже стратегической цели, что Польша должна достичь к 2020 году и ниже среднего показателя для стран ЕС.

Ключевые слова: возобновляемые источники энергии, стратегическая цель, Центральная и Западная Польша.

Анотація. Е. Калбарчук, Р. Калбарчук **Трансформація поновлюваних джерел енергії у Великопольській провінції (Польща) на початку XXI століття.** Метою дослідження було визначити зміни у використанні поновлюваних джерел енергії протягом останнього десятиліття в області провінції Великопольській (Польща). Частка енергії з поновлюваних джерел у виробництві електроенергії в досліджуваній області, за даними 2005 року не перевищує 1%. За кожен рік повідомляють про збільшення своєї частки у виробництві та споживанні електроенергії, до 7,8% в 2011 році. Середньорічний приріст з 2005 року склав близько 1 процентний пункт для Польщі і приблизно на 1.3 процентного пункту в провінції. Нинішній рівень частки поновлюваних джерел енергії у виробництві електроенергії в провінції Великопольській, як і в середньому по країні, як і раніше набагато нижче стратегічної мети, що Польща повинна досягти до 2020 року і нижче середнього показника для країн ЄС.

Ключові слова: поновлювані джерела енергії, стратегічна мета, Центральна і Західна Польща.

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