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Renewable Energy – Implications for Agriculture and Rural Development in Poland

Abstract: Due to their quantitative and qualitative potential, rural areas participate to a significant degree in the achievement of the indicative targets resulting from the climatic package. Thanks to the production of biomass and, increasingly often, energy itself during the 2005–2014 period, the share of RES (renewable energy sources) in the production of primary energy grew twofold from 5.8% to 12.1%. Biomass was the main source, but since 2010 the use of wind and sun in the production of energy has been growing rapidly. Given that the costs of alternative sources for energy production (mainly electricity) are considerably higher than in case of using raw fuels, the development of this market depends on the amount of subsidies. The system applied in Poland is widely criticized because it favours large hydroelectric power plants and co-combustion, which arouses considerable environmental, technical, market and strategic controversies. Maintaining the current support system could therefore have significant implications for the structure of the market, because it is not conducive to the development of energy, based on the initiative of citizens and their communities. It remains untapped economic potential also in industrial policy and services and, in particular, in case of RES small- and micro-installations.

Keywords: renewable energy, rural development, biofuels.

1. Introduction

How to accommodate the rate of economic growth, and therefore increased energy demand, and the need to counteract climatic change, is one of the major dilemmas of our civilisation. Energy is considered the driving force of every action and the control over its flow determines the ruling power of human beings and their relative influence on nature, it models the form of economic systems and

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affects the individual life style. The significant role of energy is confirmed by essential positive interrelations between its consumption and the economic growth or between the energy consumption and economic activity, measured both in macro and micro scale. According to the most probable scenario (*Current Policies*), developed by the International Energy Agency (Key… 2014), by 2035 the global primary energy demand will have grown by approx. 30% as compared with 2011. Therefore, energy has been and shall be the key determinant of economic activity and development of the civilisation, because every economic process must be energy-driven and energy management, particularly the energy originating from inanimate nature, is key to the availability of natural resources.

Between 1850 and 2000 the world population increased 4 times and the consumption of energy increased 20 times, in that the use of fossil fuels increased 150 times. It is the high consumption of energy, generated mainly through combustion of fossil fuels and excessive development of transport, defined as automotive industry explosion, that are the main originators of the climatic change. Hence, all the possible scenarios of economic development assume a reduction of the share of conventional fuels to the benefit of renewable energy sources (RES). The nature of the climatic policy, therefore, concentrates to a considerable extent around re-orientation of economic activity to such a development path which would be less dependent (or ultimately independent) on the traditional sources of energy, namely the fossil fuels.

Apart from its benefits to the natural environment, renewable energy also fosters competition on the energy market. It fosters improvement of energy security, allowing stable, uninterrupted delivery of energy, diversified in terms of sources, with suitable quality parameters, and socially affordable. The most popular understanding of the energy security is identified with secured import supplies (Żylicz 2012). Threats result, on the one hand, from dependence on the supply of mainly crude oil and gas from politically unstable countries, and on the other hand – from the use of exported energy raw materials to achieve political goals and extend the producers' influence on the international arena. There is also a growing risk of terrorist assaults on the infrastructure: refineries, tankers and electric energy transmission grids. An advantage of these sources is also in that they enhance security on the local scale, as dispersed power engineering causes less disturbances in the case of power grid failure or at a power plant. It also reduces the costs of construction and operation of transmission lines and contributes to the improvement of energy supply, particularly in areas with poor power engineering infrastructure, and these are mostly rural areas.

2. Objectives, materials and methods

The main objective of the study was to identify factors determining the development of the renewable energy market, with particular focus on agriculture and rural areas. The theoretical premises, level, structure and dynamics of the use of renewable energy in Poland and selected European countries in 2004–2014 were determined. The article also includes an attempt to verify the hypothesis that renewable energy sources influence the development of agriculture and rural areas. This issue is becoming particularly important in view of global determinants and those arising from European Union energy policy.

The source material consisted of information obtained from Simplified energy balances – annual data and EurObserv'ER. In addition, as renewable energy investments were co-financed by the European Regional Development Fund, the article presents the structure and spatial differentiation of the absorption of funds in the Lublin Voivodeship.

3. Polish regulations on the development of renewable energy sources

Providing broadly understood energy security and mitigating climate change are today the main challenges faced by legislative framework fixed to stimulate the development of alternative energy sources. Energy from renewable sources is one part of the system, which not only enables to ensure local energy self-sufficiency, but also contributes to a reduction of anthropogenic heat release. International climate agreements indicate the need to intensify the prevention of global warming and accelerate the reduction of CO_2 emissions. The Climate Convention (UNFCCC) established in 1992 and the resulting Kyoto Protocol signed in 1997 focused, however, primarily on reduction targets. The agreement negotiated at the 21st Climate Convention Summit in Paris (COP XXI – December 2015) assumes limiting the increase in the global average temperature to well below 2° C, which in practice comes to emission-neutral economics. And although the commitments signed in Paris give individual countries a choice of the way the objectives are to be achieved, the need to promote renewable energy sources is underlined in the document's introduction (Conference…).

The European Union emphasizes stricter links between climate policies and the development of renewable energy sources. General regulations on renewable energy were introduced in the EU as early as in 1997 (Communication… 1997); later they were made more specific in Directives 2001/77/EC and 28/2009/EC. The geopolitical situation (e.g. crisis in gas supplies via Ukraine in 2006 and the occupation of Crimea by Russia in 2014) additionally increased the EU's interest

in energy self-sufficiency and in local possibilities of energy generation. The so-called "first energy-climate package", published in 2009, got a short title "3 × 20" because (in the 2020 perspective) it assumed the 20% reduction in greenhouse gas emissions, increase of energy efficiency by 20% and increase to 20% of the share of energy from renewable sources.

Documents developed in the subsequent years (Energy Roadmap 2050 and the "second" energy and climate package of 2014) confirmed that EU was interested in the development of renewable energy, the share of which in the energy mix in 2030 should exceed 27%. According to the Commission Communication: A Roadmap for moving to a competitive low carbon economy in 2050, "Given that the central role of electricity in the low carbon emission economy requires significant use of renewables, many of which have variable output, considerable investments in networks are required to ensure continuity of supply at all times".

In Polish law the obligation to purchase renewable energy was included in the Energy Act (1997). The Act delegated imposition of this obligation to the minister in charge of the economy who, vested with such power, issued a corresponding Ministerial Regulation (1999). Both the Act and the Regulation have been amended numerous times, in part due to the need to implement European Union law, in particular the provisions of Directive 2001/77/EC. The most important changes were associated with the introduction in 2005 of property rights to Certificates of Origin, which are documents confirming the production of a specified quantity of energy from renewable sources. This system was widely criticized, because it favoured large hydroelectric power plants and biomass co-firing in thermal power plants, which are highly controversial due to environmental, technical, market and strategic concerns (Żylicz 2012). During that period there was a significant increase in financial support for this sector in the form of subsidies or low-interest credit and investment loans (Ekofundusz, NFEP&WM, the Infrastructure and Environment Operational Programme, the European Regional Development Fund, the European Economic Area). Since 2010, renewable energy policy has focused on implementation of Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources, which defines mandatory national overall targets for the total share of renewable energy in gross final energy consumption (15%) and for the share of renewable energy in transport (10%) up to 2020 (Art. 1).

Sector targets (electricity, heating, cooling and transport) and paths for Poland to achieve the required indicators by 2020 were formulated in the National Renewable Energy Action Plan (2010), whose development and implementation were imposed by Directive 2009/28/EC. In that document Poland committed to introducing legislative regulations in the form of an Act on renewable energy

sources. Such an Act was not passed until 20 February 2015. Despite many years of consultations it was widely criticized, which resulted in amendments on 29 December 2015 and again on 22 June 2016. The main dispute concerned principles governing state aid. Producers and NGOs postulated the introduction of fixed tariffs (feed-in tariffs), which involve entering into a long-term contract with an energy producer with a guaranteed price established by a regulator. Feed-in tariff systems are considered very effective in promoting specific technologies but they are costly. This latter consideration, together with the predictability and stability of energy production, was a decisive factor leading to fundamental changes made in the current law. According to the legislature, the current system of support for renewable energy use favours technologies which do not require maintaining a 'hot reserve' in the power system, such as biogas plants and biomass or hybrid installations. Furthermore, it promotes local economic initiatives such as co-operatives and energy clusters. The amended law did away with guaranteed tariffs for prosumers, replacing them with a system of rebates, and fundamental changes were made in the principles of the auction system, which replaced the system of green certificates (the proprietors of renewable energy plants who began selling energy to the grid prior to 1 July 2016 will retain the right to receive this form of support for 15 years from the moment they began producing energy, or they will be able to switch to the auction system). The new law introduced a definition of local biomass, as raw materials of agricultural origin obtained from an area with a radius of no more than 300 kilometers from the power generating facility where they will be used, which will contribute to elimination of their import and to an increase in domestic demand of about 4 million tons/year.

Regulations concerning biofuels are a very important element of implementation of Directive 2009/28/EC. In Poland the required share of biofuels in total fuel consumption for transport, calculated according to calorific value, is specified by National Indicative Targets. The target value for this share by 2020 is 10%, and the share during the period leading up to this level is given in two Regulations of the Council of Ministers (Regulation of the Council of Ministers dated 15 June 2007 and Regulation of the Council of Ministers dated 23 July 2013).

The legal framework for development of renewable energy is also defined indirectly by documents concerning the development of a low-carbon and energy-efficient economy and energy security. The National Action Plan for Energy Efficiency for Poland 2014 involves (wherever it is economically, technically and environmentally justified) the use of decentralized energy supply systems based in part on renewable energy. Moreover, the National Programme for the Development of Low-Carbon Economy (2015) lists the development of renewable energy use among priorities for low-carbon energy production.

4. Renewable energy market in the EU and Poland

In the European Union, which plays a very important role in the action towards reduction of greenhouse gas emissions, the acquisition of primary energy from renewable sources grew by more than 60% over the period 2005–2014, which means that one fourth of energy originated from RES. The highest indicators featured Austria (77.7%), Italy (64.1%), Finland (55.8%) and Spain (51.6%). Biomass and hydroelectric power engineering were the major sources of energy, including geothermal sources in Italy. In Poland, this sector also witnessed dynamic development. During the period under consideration, acquisition of energy from renewable sources grew by 83% and in 2014 it accounted for 12.1% of the total primary energy carriers (Table 1).

The growing use of RES is also considered an economic and social development stimulating factor. Companies investing in green energy introduce new technologies, generate local labour markets, strengthen the services market while contributing directly to the growth of innovativeness of a given territorial unit, promotion of its image and ultimately to local development.

The data published by EurObserv'ER Consortium show that in 2013 the value of investments on the Community market of renewable energy sources exceeded EUR 130 billion and since 2010 it has remained at a similar level (Table 2). The greatest capital expenditure included the construction of wind farms (EUR 39.8 billion), installation of photovoltaic modules (EUR 22.0 billion), equipment for the use of solid biomass (EUR 35.9 billion) and biofuel production (EUR 14.3 billion). Germany remains the leader, despite the fact that, as compared with 2010, expenditure on this objective was reduced by 18.7%. Considerably lower capex on photovoltaics (by 72.6%) was of key significance, mainly due to saturation of the market. In Denmark, the UK, France and Italy it ranged from EUR 12.5 to 17.6 billion, and in Poland – EUR 5.3 billion (by 37.4% more than in 2010). In Poland, about 40% of that amount came from wind energy and 36% from solid biomass used for energy generation. The highest dynamics was observed in the photovoltaic branch.

The increased use of renewable energy sources resulted in simultaneous growth of employment – in 2013 in the EU it amounted to 1,155 K individuals, most of them in the solid biomass sector (314.8 K), wind energy (302.5 K), photovoltaics (158.9 K) and biofuel production (989 K). These data include those employed directly in the sector of energy generation from renewable sources, and in sectors supplying the equipment and rendering respective services. The number of those employed is correlated with the volume of generated energy and the value of the investment, hence over 30% of the total accounts for Germany (370.1 K), mainly in wind,

Table 1. Gross domestic consumption and production of primary energy in selected EU Member States

Specification	Gross domestic consumption								
	total energy			renewable energy					
	2005	2010	2014	2005		2010		2014	
	mln toe			mln toe	%	mln toe	%	mln toe	%
Germany	341.9	333	313.9	17.2	5.0	27.6	8.3	35.4	11.3
France	276.6	267.1	248.5	15.7	5.7	20.8	7.8	21.3	8.6
UK	234.0	212.5	189.3	4.0	1.7	7.3	3.4	12.1	6.4
Italy	190.1	177.9	151	14.1	7.4	21.9	12.3	26.5	17.5
Spain	144.2	130.3	116.7	8.4	5.8	15.0	11.5	17.8	15.3
Poland	**92.2**	**100.7**	**94.3**	**4.5**	**4.9**	**7.3**	**7.2**	**8.6**	**9.1**
Netherlands	84.7	86.3	76.8	2.3	2.7	3.2	3.7	3.4	4.4
Belgium	56.9	61.2	53.4	1.2	2.1	2.8	4.6	3.4	6.4
Sweden	51.0	50.8	48.2	14.8	29.0	17.0	33.5	17.3	35.9
Czech Republic	45.1	44.7	41.5	1.8	4.0	3.9	8.7	4.4	10.6
Finland	34.5	37.1	34.6	8.1	23.5	9.4	25.3	10.2	29.5
Austria	34.2	34.3	32.7	7.0	20.5	9.2	26.8	9.8	30.0
Romania	39.2	35.8	32.3	4.9	12.5	5.9	16.5	6.1	18.9
Denmark	19.6	19.6	16.9	2.8	14.3	3.9	19.9	4.4	26.0
Other	187.1	172.3	156.4	14.3	7.6	18.6	10.8	20.6	13.2
UE 28	1831.3	1763.5	1606.5	121.0	6.6	173.7	9.8	201.3	12.5

Table 1 – continued

Specification	Production of primary energy											
	total energy				total energy		renewable energy					
	2005		2010		2014		2005		2010		2014	
	mln toe	Energy dependence %	mln toe	Energy dependence %	mln toe	Energy dependence %	mln toe	%	mln toe	%	mln toe	%
Germany	136.8	60.0	128.7	61.4	120.8	61.5	16.9	12.4	27.7	21.5	36.0	29.8
France	135.6	51.0	134.2	49.8	135.9	45.3	15.7	11.6	20.6	15.4	21.0	15.5
UK	203.8	12.9	147.7	30.5	107.6	43.2	3.6	1.8	5.8	3.9	9.7	9.0
Italy	30.3	84.1	33.0	81.5	36.8	75.6	13.3	43.9	19.4	58.8	23.6	64.1
Spain	30.0	79.2	34.3	73.7	34.9	70.1	8.4	28.0	14.6	42.6	18.0	51.6
Poland	**77.9**	**15.5**	**66.7**	**33.8**	**66.9**	**29.1**	**4.5**	**5.8**	**6.8**	**10.2**	**8.1**	**12.1**
Netherlands	62.5	26.2	69.8	19.1	58.4	24.0	2.0	3.2	3.1	4.4	4.6	7.9
Belgium	13.7	75.9	15.3	75.0	12.2	77.2	0.9	6.6	2.2	14.4	2.9	23.8
Sweden	34.2	32.9	32.7	35.6	34.2	29.0	14.8	43.3	17	52.0	16.7	48.8
Czech Republic	32.9	27.1	31.5	29.5	29.1	29.9	2.0	6.1	2.9	9.2	3.7	12.7
Finland	16.6	51.9	17.3	53.4	18.1	47.7	8.2	49.4	9.4	54.3	10.1	55.8
Austria	9.9	71.1	11.9	65.3	12.1	63.0	7.0	70.7	8.8	73.9	9.4	77.7
Romania	28.2	28.1	27.8	22.3	26.6	17.6	4.9	17.4	5.7	20.5	6.1	22.9
Denmark	30.8	–57.1	22.9	–16.8	15.8	6.5	2.5	8.1	3.1	13.5	3.1	19.6
Other	60.5	67.7	61.9	64.1	62.3	60.2	14.9	24.6	20.8	33.6	22.8	36.6
UE 28	903.7	50.7	835.7	52.6	771.7	52.0	119.6	13.2	167.9	20.1	195.8	25.4

Source: own study on the basis of: Energy. Simplified energy balances – annual data (nrg_100a) http://appsso.eurostat.ec.europa.eu/nui/show.do [accessed: 12.02.2016]; Supply, transformation and consumption of renewable energies – annual data (nrg_107a) http://appsso.eurostat.ec.europa.eu/nui/show.do [accessed on12.02.2016]; Primary production – all products – annual data (nrg_109a) http://ec.europa.eu/eurostat/web/energy/data/database [accessed: 12.02.2016].

Table 2. Investment by RES sectors in selected EU Member States (million EUR)

Specification	Wind Power		Photovoltaic		Solar Thermal		Smal Hydropower		Geothermal Energy	
	2010	2013	2010	2013	2010	2013	2010	2013	2010	2013
Germany	3 780	8 470	20 240	5 570	1 160	1 190	440	510	1 450	200
France	2 640	2 230	2 880	3 780	430	430	420	450	428	80
UK	4 500	6 000	1 200	2 700	75	40	100	720	75	15
Italy	3 500	1 200	8 000	2 800	490	350	600	750	600	600
Spain	6 860	10 780	270	605	50	90	5	5	5	5
Poland	**3 500**	**2 000**	**2 845**	**400**	**680**	**500**	**220**	**400**	**5**	**0**
Netherlands	470	875	215	510	420	295	500	1 000	207	15
Belgium	830	1 200	70	60	30	10	295	250	1000	15
Sweden	650	2 000	1	5	115	230	50	100	15	30
Czech Republic	840	1 300	1 000	2 000	53	50	0	0	160	90
Finland	500	900	5	1 000	20	20	15	110	26	25
Austria	780	350	5	5	5	5	35	40	145	0
Romania	370	950	1 200	380	30	50	20	15	10	40
Denmark	35	40	5 100	300	110	65	60	100	40	5
Other	1 915	9 925	1 217	1 915	324	355	495	535	183	150
UE 28	31 170	39 750	44 248	22 030	3 992	3 680	3 255	4 985	4 349	1 270

Table 2 – continued

Specification	Heta Pumps		Biogas		Biofuels		Solid Biomass		Total	
	2010	2013	2010	2013	2010	2013	2010	2013	2010	2013
Germany	720	1 700	1 510	1 750	3 050	3 700	6 060	8 140	38 410	31 230
France	280	2 140	150	410	2 520	3 180	1 370	4 930	11 118	17 630
UK	75	1 325	570	450	1 100	660	385	3 475	8 080	15 385
Italy	1 000	2 500	900	2 500	1 400	1 150	975	2 000	17 465	13 850
Spain	200	210	35	25	20	280	5	450	7 450	12 450
Poland	**0**	**350**	**65**	**65**	**1 350**	**950**	**1 320**	**1 600**	**9 985**	**6 265**
Netherlands	207	250	65	65	465	345	2 175	2 430	4 724	5 785
Belgium	1 000	620	10	50	400	750	5 350	2 650	8 985	5 605
Sweden	75	100	40	70	2 400	850	500	1 900	3 846	5 285
Czech Republic	85	400	100	75	220	600	320	325	2 778	4 840
Finland	0	0	5	10	190	190	1 057	1 225	1 818	3 480
Austria	145	400	10	15	120	200	2 240	2 350	3 485	3 365
Romania	22	50	55	35	310	310	280	300	2 297	2 130
Denmark	40	70	65	150	220	250	610	670	6 280	1 650
Other	79	275	90	150	1 025	925	3 867	3 505	9 195	9 265
UE 28	3 928	10 390	3 670	5 820	14 790	14 340	26 514	35 950	135 916	138 215

Source: own study on the basis of The State of Renewable Energies in Europe. Edition14th EurObserv'ER Report 2014 file:///C:/Users/Dell/Downloads/EurObservER-Annual-Overview-2014-EN%20(1).pdf [accessed: 12.02.2016].

Table 3. Employment by RES sectors in selected EU Member States (thousands of employees)

Specification	Wind Power	Photovoltaic	Solar Thermal	Smal Hydropower	Geothermal Energy	Heta Pumps	Biogas	Biofuels	Waste	Solid Biomass	Total
Germany	137.8	56.0	12.5	13.1	1.4	12.5	49.2	25.6	7.0*	51.6	370.1
France	20.0	26.4	6.7	3.9	1.2	32.0	3.5	30.0	0.7	52.5	176.9
UK	36.0	15.6	0.8	5.0	0.2	7.4	2.8	3.5	6.5	21.0	98.7
Italy	30.0	10.0	4.5	4.5	5.5	10.5	4.2	5.0	1.0	20.0	95.2
Spain	20.0	7.5	4.5	1.5	0.1	4.7	0.5	5.0	0.5	16.0	60.2
Poland	4.5	0.8	0.1	0.6	0.1	8.7	0.3	5.0	2.9	27.5	50.4
Netherlands	4.5	4.9	2.9	6.2	0.1	1.3	0.5	0.9	0.5	18.1	39.8
Belgium	27.5	0.5	1.2	0.1	0.1	2.5	0.2	1.5	0.6	3.5	37.5
Sweden	3.0	0.1	2.5	1.0	0.2	0.7	0.5	7.5	0.1	19.5	34.9
Czech Republic	1.5	0.1	0.1	0.4	0.0	0.7	0.1	1.0	0.1	24.4	32.4
Finland	3.5	10.0	0.5	0.4	0.1	0.5	0.4	2.0	0.7	3.3	21.3
Austria	4.0	6.5	0.3	0.1	0.4	2.8	0.7	0.6	1.3	3.3	19.9
Romania	2.0	2.5	0.3	0.5	0.2	0.0	0.1	1.0	0.1	12.5	19.0
Denmark	0.3	1.5	0.8	0.4	0.1	5.0	1.3	2.8	0.1	6.9	14.7
Other	7.9	16.5	4.0	5.2	1.8	6.9	1.1	7.5	0.4	34.7	84.1
UE 28	302.5	158.9	41.7	42.9	11.5	96.2	65.4	98.9	22.5	314.8	1155.1

* Own estimation.

Source: own study on the basis of The State of Renewable Energies in Europe. Edition14th EurObserv'ER Report 2014 file:///C:/Users/Dell/Downloads/EurObservER-Annual-Overview-2014-EN%20(1).pdf [accessed: 12.02.2016].

photovoltaics and biomass energy. In Poland the number was ten times smaller, despite similar RES technical potential (Table 3). According to a Greenpeace report, by 2020 the net employment (taking into account the changes in coal mining and conventional power engineering) in Poland will have grown by 155 K (Working… 2011). The largest number of jobs (about 100 K) will be generated in district heating, through the use of biomass and in electric energy sector (40 K).

The structure of harvesting energy from renewable sources in the EU shows that biomass has hitherto been the most important, as it is generally available and may be used for direct combustion (e.g. wood, straw, sewage sludge), or may be processed into liquid fuels (e.g. rapeseed oil esters, alcohol), or gaseous fuel (e.g. agricultural biogas, biogas from WWTP, dumping site gas). It belongs to those RES which do not require keeping the so-called "hot reserve" in the power dispatch system, as in the case of photovoltaic or wind farms, which has for years been disputed in power engineering sector and caused prolongation of work on legislation which was of major significance to the development of renewable sources. The RES Act passed in February 2015 was amended in December that same year and in June 2016, with future modifications already announced.

Biomass was used mainly in district heating, electric energy generation, biogas plants and for production of biofuels. Its share in the final energy from RES differed among the Member States, from 38.2% in Spain to 89.5% in Poland (Table 4). However, its share declined from 67.7% in 2005 to 64.1% in 2014, with wind and solar energy gaining significance actually solely due to subsidy systems guaranteed by the state.

In the EU, dispersed generation and increasing the share of by-products and organic wastes used mainly for production of new generation biofuels are the preferred direction of the RES use development. This creates huge opportunities for rural areas and agriculture, where more than half of the global production consists of waste.

Table 4. Production of energy from renewable sources and its share in selected EU Member States

Specification	RES			Biomass			Hydro energy			Wind Energy		
	2005	2010	2014	2005	2010	2014	2005	2010	2014	2005	2010	2014
	mln toe						%					
Germany	17.2	27.6	35.4	74.4	75.7	70.3	9.9	6.5	4.8	13.4	11.6	13.8
France	15.7	20.8	21.3	69.4	68.3	63.8	28.0	26.0	25.4	0.6	4.3	7.0
United Kingdom	4.0	7.3	12.1	82.5	83.6	69.4	10.0	4.1	4.1	5.0	12.3	23.1
Italy	14.1	21.9	26.5	42.6	53.0	48.3	22.0	20.1	18.9	1.4	3.7	4.9
Spain	8.4	15.0	17.8	58.3	44.0	38.2	19.0	24.0	19.1	21.4	25.3	25.3
Poland	**4.5**	**7.3**	**8.6**	**95.6**	**94.5**	**88.9**	**4.4**	**4.1**	**2.3**	**0.0**	**1.4**	**8.2**
Netherlands	2.3	3.2	3.4	91.3	87.5	82.4	0.0	0.0	0.0	8.7	9.4	14.7
Belgium	1.2	2.8	3.4	91.7	92.9	79.4	0.0	0.0	0.0	0.0	3.6	11.8
Sweden	14.8	17.0	17.3	57.4	64.7	62.4	42.6	33.5	31.8	0.7	1.8	5.8
Czech Republic	1.8	3.9	4.4	88.9	61.5	72.7	11.1	5.1	4.5	0.0	0.0	0.0
Finland	8.1	9.4	10.2	85.2	87.2	87.3	14.8	11.7	11.8	0.0	0.0	1.0
Austria	7.0	9.2	9.8	51.4	59.8	57.1	45.7	35.9	35.7	1.4	2.2	3.1
Romania	4.9	5.9	6.1	65.3	69.5	62.3	34.7	28.8	26.2	0.0	0.0	8.2
Denmark	2.8	3.9	4.4	82.1	82.1	72.7	0.0	0.0	0.0	21.4	17.9	25.0
Others	14.3	18.6	20.6	74.1	70.4	66.5	20.3	24.2	19.9	2.8	7.5	10.7
UE 28	121.0	173.7	201.3	67.7	68.6	64.1	22.2	18.7	16.0	5.0	7.4	10.8

Table 4 – continued

Specification	Solar Energy						Other		
	thermal			photovoltaic					
	2005	2010	2014	2005	2010	2014	2005	2010	2014
Germany	1.7	1.8	1.7	0.6	3.6	8.8	0.0	0.7	0.6
France	0.0	0.5	0.5	0.0	0.5	2.3	1.9	0.5	0.9
United Kingdom	0.0	0.0	0.8	0.0	0.0	2.5	2.5	0.0	0.0
Italy	0.0	0.5	0.8	0.0	0.9	7.2	34.0	21.9	20.0
Spain	1.2	3.3	13.5	0.0	4.0	3.9	0.0	0.3	0.0
Poland	**0.0**	**0.0**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**
Netherlands	0.0	0.0	0.0	0.0	0.0	2.9	0.0	3.1	0.0
Belgium	0.0	0.0	0.0	0.0	0.0	0.0	8.3	3.6	8.8
Sweden	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Czech Republic	0.0	0.0	0.0	0.0	2.6	4.5	0.0	30.8	18.2
Finland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
Austria	1.4	2.2	2.0	0.0	0.0	1.0	0.0	0.0	1.0
Romania	0.0	0.0	0.0	0.0	0.0	1.6	0.0	1.7	1.6
Denmark	0.0	0.0	0.0	0.0	0.0	2.3	–0.9	0.0	0.0
Others	1.4	1.6	1.9	0.0	0.0	3.9	0.6	0.2	0.1
UE 28	0.6	1.0	2.0	0.1	1.1	3.9	4.4	3.2	3.1

Source: own study on the basis of Energy. Supply, transformation and consumption of renewable energies – annual data (nrg_107a) http://appsso.eurostat.ec.europa.eu/nui/show.do [accessed: 12.02.2016], data base for Poland in 2014: Energia ze źródeł odnawialnych w 2014 r. GUS, Warsaw, p. 25.

5. Renewable energy as an impetus to rural development

Up to the end of the previous century, rural areas, which occupy over 93% of the surface area of Poland, were associated with agriculture and production of food or raw materials mainly for food industry. Although that significant role of agriculture will not decline, because of income growth in relatively poor countries with high flexibility of food demand, these areas are going to serve a number of other important functions. One of them is the production of energy from renewable sources and energy. So far, energy harvested in this way has in most applications been more expensive than energy generated by means of conventional methodd, but time is working in favor of renewable energy sources, which are no longer a whim and are becoming – thanks to the development of new technologies – the mainstream in the energy sector (Wiśniewski 2015).

In Poland, the economic potential of renewable energy sources was estimated at 39.5 Mtoe; more than half of these resources falls on biomass (Instytut… 2007). Full use of this potential would cover 50% of the forecast in the Polish Energy Policy 2030 (Energy… 2009; National… 2010) final energy demand (Table 5). The following forecasts show that about 90% of energy produced from renewable sources will come from biomass, mainly solid, which until 2004 was used primarily for heating in households. The introduction in 2005 of the Tradable Green Certificates system (TGCs) for electricity producers significantly increased the demand for this type of fuel for the electricity sector. In 2014, it was twenty times higher than in 2004 and amounted to 787.6 ktoe, exceeding by more than half the assumptions resulting from the PEP 2030.

Although TGCs contributed to an increased demand for biomass they are generally criticised, as they promote co-firing of biomass in thermal power stations, arousing a lot of environmental, technical, market and strategic controversies. In the period 2005–2014 such power plants generated between 22.4% (2013) and 498% (2009) of electric energy generated from RES. On assumption that from 1 MWh of chemical energy comprised in biomass we can generate 0.2 MWh of electric energy, and the calorific value of 1 t of biomass is 3.4 MWh, then in 2014 over 6.5 million tons of this fuel was used to generate electricity (4462.2 GWh – 0.38 Mtoe). If these calculations also include energy (4256.7 GWh) from dedicated units (they are only fuelled with biomass), characterised by higher efficiency (0.35), then its total consumption amounted to over 10 million tons (2.9 million toe), which is equivalent to about 6 million tons of good quality coal.

Its major part came from imports, which grew almost eight times since 2008: from 423 to 3,591 K tons, and its value exceeded PLN 1.2 billion. Import of biomass of agricultural origin was featured by higher dynamics (1 160%), including primarily

Table 5. Forecast Demand for the final gross energy and renewable sources up to the year 2030 (in ktoe)

Specification	2006	2010	2015	2020	2025	2030	2010	2014
Electricity	**370.6**	**714.9**	**1,516.1**	**2,686.7**	**3,256.3**	**3,396.3**	**936.3**	**1,706.1**
Solid biomass	159.2	298.5	503.2	892.3	953.,0	994.9	507.7	787.6
Biogas	13.8	31.4	140.7	344.5	555.6	592.6	34.2	70.2
Wind	22.0	174.0	631.,9	1,178.4	1,470.0	1530.0	143.1	660.0
Water	175.6	211.0	240.3	271.4	276.7	276.7	251.0	187.6
PV	0.0	0.0	0.0	0.1	1.1	2.1	0.0	0.6
Heat	**4 312.7**	**4 481.6**	**5 046.4**	**6 255.9**	**7 048.7**	**7 618.4**	**5 256.3**	**5 218.2**
Solid biomass	4 249.8	4 315.1	4 595.7	5 405.9	5 870.8	6 333.2	5 151.3	5 044.5
Biogas	27.1	72.2	256.5	503.1	750.0	800.0	83.2	136.9
Geothermal	32.2	80.1	147.5	221.5	298.5	348.1	13.4	20.2
Solar	3.6	14.2	46.7	125.4	129.4	137.1	8.4	16.6
Biofuels r transport	**96.9**	**549.0**	**884.1**	**1 441.0**	**1 632.7**	**1 881.9**	**675.1**	**680.5**
Bioethanol (I generation)	61.1	150.7	247.6	425.2	443.0	490.1	188.9	131.5
Biodiesel (I generation)	35.8	398.3	636.5	696.8	645.9	643.5	486.2	549.0
Bioethanol (II generation)	0.0	0.0	0.0	210.0	240.0	250.0	0.0	0.0
Biodiesel (II generation)	0.0	0.0	0.0	112.1	213.0	250.0	0.0	0.0
Bio-hydrogen	0.0	0.0	0.0	0.0	90.8	248.3	0.0	0.0
Total final gross energy (RES)	**4 780.2**	**5 745.5**	**7 446.6**	**10 383,6**	**11 937,7**	**12 896,6**	**6 867,7**	**7 604,8**
Final gross energy (total)	**61 815.0**	**61 316.0**	**63 979.0**	**69 203.0**	**75 480.0**	**80 551.0**	**67 450.7**	**68 162,4**
Renewable energy share [%]	**7.7**	**9.4**	**11.6**	**15.0**	**15.6**	**16.0**	**10.2**	**11.2**

* actual domestic consumption.

Source: Ministry of Economy: Poland's Energy Policy 2030, Appendix 2, Forecast demand for fuel and energy up to 2030, Warsaw 2009, p. 12. Own study based on *Balance of energy from renewable sources by media in 2010–2014. Energy from renewable sources in 2014.* Central Statistical Office, Warsaw 2015, p. 51–68.

sunflower and palm shells. It was the result of introducing limitations on the use of wood for energy generation. The majority of imported biomass originated from the neighbouring countries (76.1%), mainly Ukraine (44.8%) and Belarus (23.1%), but it was also delivered from Indonesia and Malaysia (16.5%). **As a result of such significant growth in imports, since 2012 the supply of biomass in Poland started to exceed the demand, thus leading to a price drop and a wave of bankruptcies on the market which has only recently been developed with such big efforts.**

Such methods of using biomass for energy generation purposes have little in common with sustainable development and actions for reduction of CO_2 emissions. In view of its physical and chemical properties, primarily low calorific value/volume ratio and a broad range of humidity affecting the cost of shipment and storage, biomass should be used locally, as close as possible to the place of origin and mainly for thermal energy generation. From the volume of biomass used in 2014 to generate 8,718.9 GWh of electric energy, it is possible to generate 33,797 GWh (121.7 PJ) of thermal energy in households or small local heating stations, while abandoning the use of coal. This is as much as households used in 2014 (mainly wood) without any subsidies, only based on economic calculations. Even after passing the RES Act and its amendment, the hitherto system of support favoures electric energy generation according to the hitherto principles, while the radius of biomass harvesting for RES installations is limited to 300 km.

In Poland one can find many proven examples and good practices. In Grabowiec (Zamojski poviat, Lubelskie voivodeship) and Zielonki (Sztumski poviat, Pomorkie voivodeship) heating systems fuelled with straw (1,0 MW_c) have been in operation for the recent 20 years, and in Nowa Dębia (Tarnobrzeski poviat, Podkarpackie voivodeship) since 2003 wood chips have been used as fuel (8 MW_c), some of them are acquired from own willow plantations. The projects are innovative in the Polish conditions, both in terms of technologies applied and organisation of the fuel supply system. **After many years of acquiring experience it can be said that all the assumed targets have been achieved, including the most important ones, namely withholding the uptrend in thermal energy prices, which in the 2015/2016 season were among the lowest in Poland**. Moreover, the biomass was purchased from local suppliers and waste from its combustion is neutral to the environment. Implementation of these projects was primarily the result of courage, proactiveness and creativity, sometimes even a hobbyist kind of approach of the gmina authorities or entrepreneurs, rather than of systemic solutions.

Dispersed generation and increasing the share of by-products and organic waste use mainly for production of new generation biofuels are the preferred directions of the RES use development. This creates huge opportunities for

agriculture, where over half of the global production consists of a mass unfit for consumption (Smil 1999). Such conditions are met by biogas production, particularly from animal faeces, manure and organic wastes – their uncontrolled decay is a considerable source of methane emissions. Despite the significant raw material potential in Poland in 2014 the total power of installed power plants which used biogas was 187 MW_e, of which 68 MW_e in agricultural biogas plants, while in Germany the values were: 3905 MW_e and 3596 MW_e respectively. Based on this comparison we may assume that these resources are located in agriculture, as confirmed by a significant growth in production capacity (eleven times) and electric power generation (eight times) as compared with 2010. Across the whole biogas sector the increment was twofold. As at 18 February 2016 the register kept by the President of the Agricultural Market Agency included records of already 81 agricultural biogas plants with total biogas output of 335.8 million m^3/year and power of 86.9 MW_e. However, further development of this branch depends on the level of support. The current one (mainly the green certificates) proved ineffective and most of the biogas plants generated losses. Hence the amount of electricity and heat generated from biogas in 2014 was half lower than assumed in PEP 2030.

The importance of this source of energy is reflected in the document adopted by the Council of Ministers in 2010 "Directions of development of agricultural biogas plants in Poland in 2010–2020" (2010). **Its implementation would affect the diversification of gas supplies. The actually available potential of gas is 1.7 billion m^3 per year. i.e. over 10% of the national consumption and could completely satisfy the needs of recipients from rural areas.** Therefore, the RES Act amended in June 2016 provided for the establishment of a separate support system of electricity production in agricultural biogas plants (among other things, a minimum reference price was guaranteed along with a separate auction system).

Fulfillment of the obligations arising from Directive 2009/28/ EC, concerning the share of biofuels in liquid fuels and their implementation by the refining industry and transport, is of great importance, mainly for the market of cereals and oilseed rape, i.e. for farmers' income. By 2020 their share of the transport fuel market is projected to reach 10%. In the period 2010–2014 approximately 1.0–1.6 million tones of rape and 0.8 million tons of cereals were used for this purpose (Borychowski 2016). Such a result can contribute to the increase in agricultural income and income disparity reduction; it can also improve the access to goods and services for rural population as compared to the population of urban areas (Matyka 2011; Rosiak, Łopaciuk, Krzeminski 2011; Zegar 2012a). In addition, according to J. S. Zegar (2012b) the increase in demand for agricultural commodities for the production of biofuels creates an opportunity for eliminating the demand constraint which

inhibits the development of agriculture. Another important benefit associated with the development of the sector of liquid biofuels is the processing of oilseeds so that a significant amount of high-protein post-extraction pellets, which are an important component of feedstuffs, is produced domestically (Gradziuk 2003; Sobierajewska 2009). This makes it possible to reduce the imports of feed protein, primarily soybean meal which includes genetically modified seed.

To date almost the whole biofuel production sector in the EU has competed for raw materials with the food production sector, which arouses numerous controversies.

Krugman (2008), Buckwell (2008) and Szajner (2013) argued that countries which follow policies supporting the biofuels sector should withdraw from it, because this is a wrong policy, which results in the rising prices of agricultural raw materials and food.

Hence the demands of many stakeholders made the European Parliament (Resolution 2013) and the European Socio-Economic Committee (Opinion… 2012) apply for amending Directive 2009/28/EC in order to reduce preferences for producers who use such substrates. According Prandecki and Floriańczyk (2014) and Zegar (2014) the increase in biofuel production on agricultural markets is deliberately overestimated and, in fact, lower than generally assumed and that biofuels are one of the less important reasons for the increase in prices.

By the decision of the European Parliament of 2013, the share of biofuels (biofuel crops must be grown on the land which was previously used for food crops) in the total energy consumption in transport in 2020 was limited to 6%. The rest must be made up of second generation bio-components (produced from waste, algae and cellulose). The restriction concerns not only raw materials, but also energy plants, the cultivation of which also involves changing the current method of land use. According to the experts of the National Chamber of Biofuels the decision will negatively affect the profitability of agricultural production, mainly cereals and rape (Gzyra 2014).

Polish energy sector has one of the highest shares of biomass in energy production from renewable sources. In 2014 it reached approximately 90% and its economic potential was used in 35%. However, there is a wide variation depending on the type of raw material and its intended use. So far, the main sources of biomass used in the power industry have included wood and wood waste. Despite the 80% increase in the raw material supply, as compared to 1995, it did not fully satisfy the demand, which resulted in protests of the hitherto customers. Therefore, a provision was made in the "Polish Energy Policy 2025" "that biomass would be the basic target of development of renewable energy sources, but this should not lead to shortages of wood for wood-processing industry, including pulp and

paper production". Wet waste biomass is the one relatively most available (it is used in the process of anaerobic digestion (3.0 Mtoe)) along with straw (2.7 Mtoe).

In view of a significant technological progress in the field of renewable energy, which results in lower and lower equipment costs and higher energy efficiency, the interest in using wind and solar energy has been increasing. In 2014 the amount of electricity generated from wind power plants was 5% higher than assumed in PEP 2030 and the "National Action Plan for Energy from Renewable Sources" for 2015. In the photovoltaics sector the value was six times higher in relation to 2020. Given the ability of power generation per unit area of the territory of Poland, which include: solar thermal energy – 1,440 TJ/km^2, photovoltaic solar energy – 360 TJ/km^2, wind energy – 70 TJ/km^2 and a biomass – 15 TJ/km^2 (Wiśniewski 2015), one can conclude that renewable energy could provide a boost to rural development. To verify the hypothesis, an analysis was conducted of the allocation of funds from the Regional Operational Programme of the Lublin Voivodeship (ROPLV) among districts in 2007–2013, with particular focus on outcomes obtained under Measure 6.2 'Environmentally friendly energy'. This voivodeship was chosen for two reasons: it has one of the lowest urbanization rates (46.2% in 2013) and the largest amount of funds from the regional operational programme spent on implementation of investments using renewable energy (PLN 265.5 million, which was 5.9% of all allocated ROPLV funds). Over 93% of this sum was allocated for investments in solar energy, mainly solar collectors (92.6%). Although the primary beneficiaries were local government units, the target group was households, mainly in rural areas (97%), in which over 32,000 collectors with a combined thermal power of 156.4 MW$_t$ were installed. Such a high level of interest among households in the use of solar power to produce hot water was due to the potential savings arising from reduced expenditure on the purchase of energy carriers. The large share of projects involving the use of solar energy confirm the proposition arising from the Renewable Energy Development Programme for the Lublin Voivodeship (REDPLV) [2014], according to which solar energy resources, which are considerable for Poland, will enable the region to achieve the position of national leader in exploiting solar energy to produce heat and electricity. On the other hand, the relatively small share of funds allocated to energy use of biomass (4.4%), enabling the installation of 800 boilers with a combined capacity of 24.3 MW$_t$, was somewhat surprising. Numerous analyses indicate that the use of biomass, depending on the district, would meet from 20% to 69% of heating needs – the most in the districts of Parczew, Hrubieszów, Janów, Biłgoraj, Kraśnik and Włodawa. REDPLV also specifies that renewable energy development should be carried out using biomass obtained from agriculture and the agri-food industry. Funds spent for this purpose accounted for over 30% of the total sum obtained under ROPLV. This and other measures suggest

that local governments of this region see development opportunities in the dynamic growth of the use of locally available energy sources.

Beside the production potential issue (energy production in the rural areas), it can contribute to the improvement of energy supply. According to Bukowski and Karaczun (2015) "low quality of energy services, especially interruptions in the supply of energy to end-users, primarily in rural areas, is a constraint on innovative technical development and one of the main reasons for the backwardness of the peripheral areas". The development of RES is sometimes seen also as a guarantee for the modernization of infrastructure (including obsolete electrical networks) in rural areas (Bańkowska 2015). According to a survey conducted by the Institute for Renewable Energy (under the projects: "An Energetic Farmer", www.gospodarzzenergia.pl and OZERIS, www.ozerise.pl) 54% of the surveyed farms experienced the consequences of low quality energy, resulting in damage or destruction of electrical appliances, losses of product quality which indirectly influenced the slowdown in farm development. At the same time as many as 63% of the respondents declared no protection against network failure, 25% were using small private generators, 8% – a battery and only 4% considered a possibility of additional support in the form of a renewable energy source. Also, the "Strategy of Energy Security and Environment 2020" in its part concerning the development of energy supply in suburban and rural areas points out two important aspects – the problem of power outages in rural areas (e.g. in the aftermath of extreme climatic conditions) and the importance of energy generation from renewable sources as a form of non-agricultural activity. Moreover, the "National Plan of Renewable Energy Micro-Installation Development by 2020" underlines the importance of job creation in the assessment of socio-economic effects of energy strategies implemented and points out that renewable energy contributes to the creation of the largest amount of sustainable jobs outside industrial centres. Both documents mentioned above refer to full-time jobs created for the purpose of constructing RES installations and their operation, mainly within the SME sector.

In the discussion on a positive influence of RES sector on job creation one can also hear negative opinions which point to the fact that the future operation of potential installations in rural areas may require urban workforce due to its better job qualifications. Build Up Skills Calculations (dedicated to balancing the labour market and vocational training to the needs of energy-efficient construction and renewable energy sources) show that the estimated number of graduates of RES dedicated vocational courses (renewable energy systems technician) during the 5-year period (2013–2018) would reach approx. 4.8 thousand, while the demand for qualified technicians is going to exceed 21.7 thousand in 2020. Thus, it is necessary to support the sector by sourcing graduates in other fields related to construction and by

off-school system of training courses. It therefore remains an open question whether, in the reality of surplus demand for skilled workers for the renewable energy industry, the rural areas will be a sufficiently attractive work place. Sidorczuk-Pietraszko (2015) points out that employment rates decrease with time (with the RES-project life-cycle), and the work associated with the ongoing operation of equipment "can be secured based on a service contract," which indicates a possibility of excluding the installations of renewable energy from the local labour market. This problem may be solved by adoption of a strategy for the development of dispersed renewable energy, where employment rates are higher than in case of high power installations, and where more people are employed on a regular contract of employment.

In The Strategy for Energy Security and Environment by 2020 – fostering the creation of green jobs is accompanied by promoting environment-friendly attitudes, change of attitudes and knowledge transfer. TNS studies show that approx. 81% (2014) of Poles know and understand the concept of renewable energy, and energy is the most popular among the thematic areas of research on environmental awareness. According to the CBOS, Poles consider RES "the most promising and the least expensive" and support for the concentration of investments in renewable energy is growing significantly (in 2015 it was declared by 42% and in 2016 by already 50% of respondents). These results, however, do not differentiate the respondents to the inhabitants or urban and rural areas.

Ancygier and Szulecki (2013) indicate positive attitude of local municipal authorities to RES (as local economic stimulators) and cautious support of the inhabitants ("while solar and water energy are positively assessed by both local authorities and residents […] the energy from wind and biogas is controversial"). German experience described in the National Plan of Development of Micro-Installations in Renewable Energy Sector by 2020, points to the importance of involving citizens in the process of investment – 11% of all renewable energy investors in Germany were farmers. According to Polish estimates, approx. 56% (2013) of farmers expressed their willingness to invest in small household energy source. Farmers were also a group of respondents who accept the relatively longest period of awaiting the expected return on investment. Return on investment, lack of funds and know-how are often cited as a potential constraint on the development of renewable energy sources in the rural areas. The idea of energy micro-cluster (currently under public consultation) is one of possible solutions to the problem.

6. Conclusions

It can be concluded from the analyses that in the years 2005–2014 energy production from renewable sources increased by over 60% in the EU and doubled

in Poland. The structure of renewable energy production indicates that thus far biomass has had the most significant role, used mainly for heating and electricity, in biogas plants, and for biofuel production. From the beginning of the second decade of the 21st century its share has decreased, while wind and solar energy have taken on growing importance. This was mainly due to subsidization of the development of this energy sector and to the continually decreasing costs and increasing energy efficiency of photovoltaic and solar installations. The analysis of the distribution of funds for co-financing of renewable energy investments revealed that they were mainly located in rural areas. This suggests that agriculture and rural areas can, owing to their considerable biomass resources and favourable natural conditions, become a significant producer of energy raw materials and energy, without detriment to food production, and can certainly become energy self-sufficient. The main advantages of renewable energy include a much smaller impact on the environment and increased diversification of the energy supply, which contributes to increased competition and improves energy security. Distributed generation available close to customers reduces transmission losses and delivery costs, reduces or delays the need for network expansion, and reduces the potential deficit of power in the energy peak. A recipient of power from an independent source benefits from lower energy consumption costs accompanied by improved energy quality and reliable delivery. Finally, the use of renewable energy has a favourable impact on local and regional development.

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Energetyka odnawialna – implikacje dla rolnictwa i rozwoju obszarów wiejskich w Polsce

Streszczenie: Obszary wiejskie z uwagi na swój ilościowy i jakościowy potencjał w istotny sposób uczestniczą w realizacji celów wskaźnikowych wynikających z pakietu klimatycznego. To dzięki wytwarzanym surowcom energetycznym, a także coraz częściej energii w latach 2005–2014 dwukrotnie zwiększył się udział OZE w produkcji energii pierwotnej: z 5,8 do 12,1%. Jej głównym źródłem była biomasa, ale od 2010 r. znacznie szybciej wzrasta wykorzystanie energii słonecznej i wiatrowej. Z uwagi na to, że koszty wytwarzania (głównie energii elektrycznej) są znacznie wyższe niż w źródłach wykorzystujących paliwa nieodnawialne, rozwój tego rynku jest uzależniony od wysokości subwencji. System obowiązujący w Polsce jest powszechnie krytykowany, ponieważ mimo wprowadzanych zmian preferuje duże hydroelektrownie i współspalanie budzące wiele kontrowersji ekologicznych, technicznych, rynkowych i strategicznych. Utrzymanie obecnego systemu wsparcia może zatem mieć znaczący wpływ na strukturę rynku, ponieważ nie prowadzi do rozwoju energetyki na bazie inicjatyw obywateli i ich wspólnot. Niewykorzystany pozostaje też potencjał gospodarczy w polityce przemysłowej i w usługach, a w szczególności dotyczy to segmentu mikroinstalacji i małych instalacji OZE. Realizacja zobowiązań wynikających z unijnej polityki klimatycznej i energetycznej może być impulsem dla rozwoju obszarów wiejskich.

Słowa kluczowe: energia odnawialna, rozwój obszarów wiejskich, biopaliwa.