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DEVELOPMENT OF ENVIRONMENTAL POLICY INSTRUMENTS FOR RENEWABLE ENERGY SOURCES BY MUNICIPALITIES

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ABSTRACT: An increase in the share of renewable energy in total energy consumption is one of the priorities of the European Union. Poland should have achieved the level of 21% renewable energy by 2030. Research problems discussed in the article: lack of studies in communes regarding the comprehensive assessment of unused reserves of energy from renewable energy; lack of analyses regarding the costs of obtaining and using power from renewable sources, lack of clear vision of communes as subjects in the climate and energy-related policy. Considering these research problems, this paper analyses the instruments of support for energy generation from renewable sources applied by communes. The study covers one hundred communes in the voivodship of Warmia and Mazury. The following hypothesis can be put forward in the methodological context: renewable energy use in a commune depends mainly on the undertaken activities and local initiatives.

KEYWORDS: development, renewable energy, commune, instruments

Introduction

The global energy system has entered a new phase of a radical transformation. Overall, this set of shifts is usually called an Energy Transition; however, ideas about the rate of this transformation and the depth of this process are very considerably (Smil, 2018). The scenarios describing the transformation taking place at varying speeds will be discussed in the next section. This section is devoted to analysing the two main drivers of these transformations – the rapid development and the diffusion of new technologies and changes in energy policy (European Commission, 2018). The process of conversion to a model of sustainable development is based on the formation of the energy sector with a predominance of renewable energy sources, the use of which is growing extremely fast around the world. It is estimated that alternative energy sources will provide more than 40% of global demand by 2040.

According to the International Renewable Energy Agency, the share of renewable energy in the energy sector should increase from 25% in 2017 to 85% in 2050. By 2050, renewable energy sources may account for more than 60% of the total final consumption of many countries, which is 2.5 times higher than the current rate of renewable energy. For example, China is able to increase the share of renewable energy in its total energy consumption from 7% in 2015 to 67% in 2050, and the EU's claim may be increased from 17% to more than 70% (Kalinina et al., 2021).

Wholesale electricity prices in European countries are, on average, 30% higher than in the US. Wholesale natural gas prices are still nearly twice as high as in the US. Such price differences (compared to one of the most competitive economies in the world) have a significant impact on the situation and competitiveness of the EU industry, in particular when considering its energy-intensive sectors (Hansen & Percebois, 2015). The analysis of the renewable energy sector is somewhat optimistic in light of the above indicators. European companies representing this industry have a combined annual turnover of 129 billion euros and employ over one million people (European Commission, 2015).

An overview of the literature

Energy is essential in promoting sustainable development (Agenda, 2020). Many countries are striving to achieve this goal. Create a new concept of energy development and evaluate their energy systems in terms of compliance with the goals of sustainable development (Borys, 2010; Borys, 2011). The rapid changes in the natural environment and the challenges faced in

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energy management have motivated the European Union countries to update the assumptions regarding climate and energy-related issues (Ministerstwo Gospodarki, 2015; Strategia, 2017). The energy generation model valid until the end of 2020 was based on a 20% reduction in the GHG emissions, a 20% increase in the renewable energy share in the total energy consumption and a 20% improvement of energy efficiency compared to the 1990 level (Krajowy plan, 2011).

Due to the dynamics of adverse changes in the climate and energy-related areas, new, more ambitious goals were set for the EU countries for the period until 2030: 40% reduction of GHG emission, 32% increase in the renewable energy (RES) share in the total energy consumption, 32.5% increase in energy efficiency (Skoczkowski, 2002). As part of this new climate and energy system, the EU member states undertook to develop long-term national strategies and to ensure their consistency with the national plans for energy and environment by 2030 (Sokołowski, 2010).

As a member of the European Union, Poland actively participates in creating the community energy policy and implements its primary goals in the specific national conditions, considering the protection of the recipients' interests, energy resources at its disposal and technological needs of energy generation and transfer (Lorek, 2007). An increase in the share of renewable energy in total energy consumption is one of the priorities of the European Union in the climate and energy policy. Considering the progress in RES development and the national economic and legal environment, each country has the level set by the European Commission, which it is supposed to achieve pole (Ciepielewska, 2016). Poland should have achieved a 21% renewable energy share in the total energy consumption by 2030, which is an ambitious goal given the current progress. The estimated percentage of renewable energy in the total energy consumption in Poland was 11.7% as of the end of 2018. The Ministry of Energy assumes that the goal will be achieved in stages: 15% of the RES share by 2022, subsequently 17% – by 2025, and 19% – by 2027 (Polityka, 2018).

An increase in renewable energy generation becomes increasingly important in the context of the economic and political crisis that Europe has been experiencing in recent years pole (Wierzchowska, 2016). When formulating the guidelines for the energy policy, the European Union subordinated them to the principle of sustainable development, which has been adopted as a rule for the socio-economic development of the entire Union (Tomaszewski, 2018). Therefore, the European Union has departed from having an energy policy in its traditional sense, i.e., to generate energy in an amount sufficient to satisfy the demand from a specific country, without paying much attention to the environmental consequences (Czech, 2016).

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There are two tendencies observed in the European energy policy: globalisation and the development of local energy generation (Gielen et al., 2019). They are developing independently and are equally important but on a different scale. In line with the EU strategy, the perspectives for further development depend on the ability to raise the level of innovation through institutional incentives in all Member States (Cirani et al., 2016). The responsibility for creating conditions for innovation-driven growth fell on Regional Authorities – they have responded by forming Regional Innovation Strategies (RIS is the essential tool for shaping the innovation policy at the regional level).

Investments in renewable energy and its efficient use are the basic actions aimed at developing renewable energy generation effectively. These actions have to be expected on the local scale, in communes, and local communities. In the Polish institutional environment, the local government should be jointly responsible for the national energy policy by creating the local energy policy based on its energy potential. The relationship between the local and national energy policy is different for each commune, and it depends on the conditions specific to a particular territorial unit (Piechota, 2014). The specificity and quality of these relationships are decided by the commune authorities, who can approach the policy they create strategically or improvise. In the former case, the local authorities plan and carry out specific actions which make up the energy policy process.

In contrast, in the latter – they wait for the activity and involvement of government authorities. The energy policy implemented by local authorities is becoming increasingly popular in Poland. Unfortunately, this is mainly among the institutions, organisations and experts involved in energy-related issues daily.

Regarding the renewable energy sector, local governments restrict themselves to following the legal regulations, with minimal or no work of their own (Schuh et al., 2012). One of the essential elements of the modern energy sector, its democratisation, is being observed consisting in the described bottom-up arising new sources of renewable energy in a distributed system. This way, a new model has created a market where there will be fewer and less customers dependent on producers and distributors (Kurtyka, 2021).

The participation of communes in the renewable energy sector support system and indicating the potential organisational and legal framework in which the commune can perform its activities is one of the significant issues associated with the practical implementation of the law by communes (Ustawa, 2020). In accordance with the Communal Local Government, the commune's tasks include electricity, heat and gas supply". It appears that a commune's activities related to electricity generation from renewable sources are within the sphere of the commune's tasks related to the electricity supply

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(Gawlikowska-Fyk, 2014). In theory and practice, two types of applied instruments of environmental policy can be distinguished: direct, the so-called administrative and legal, used almost exclusively from the beginning, and indirect, the so-called economic and market, which appeared along with the need to economise the ecological policy (Fiedor & Graczyk, 2006; Graczyk, 2015).

However, one should note that it is not the commune that supplies electricity to its residents, but rather it is done by a power supply company. Nevertheless, the commune is one of the major entities participating directly or indirectly in pursuing the climate and energy-related goals set by the European Union. Moreover, prosumer/low-wave energy generation could contribute to the stimulation of development in less-developed regions (Graczyk, 2018). The paper analysed the commune management of energy from renewable sources. The following issues should be mentioned when justifying the subject choice: lack of studies in communes regarding the comprehensive assessment of unused reserves of energy from renewable energy; lack of analyses regarding the costs of obtaining and using energy from renewable sources, and lack of clear vision of communes as subjects in the climate and energy-related policy.

Research methods

Considering these research problems, this paper analyses the instruments of support for energy generation from renewable sources applied by communes. The aim of the research is to analyse the level of renewable energy use in the surveyed municipalities through the prism of the available methods and tools enabling the development of renewable energy sources. The study covers one hundred communes in the Voivodship of Warmia and Mazury. The following hypothesis can be put forward in the methodological context: accomplishing the objective of increasing the share of energy from renewable sources in the total energy consumption depends mainly on communes' initiatives. The energy policy and the energy sector are the basis for the effective functioning of the European and Polish economy. Poland faces the following threats if appropriate actions aimed at using renewable energy sources (at the commune level) are not implemented: an increase in the production costs, an economic slowdown in the area and, later, slow depopulation and an economic crisis. The paper methodology involves (on a general level) the regional realism theory. It will be used to illustrate the particular interests of individual communes regarding the use of the energy generation sector instruments. The subjects of the research are 100 communes in the Warmian-Masurian Voivodeship. The basic tool used for collecting factual

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knowledge is internal documents of communes, as well as surveys among various social groups living in the studied communes: local government employees, entrepreneurs, and residents. The survey consists of 5 main research areas, including 50 specific questions. The research was conducted in 2020. The survey return rate was 90%. The statistical and survey research will make it possible to carry out analyses related to the assessment of the potential of renewable energy, the analysis of the conditions related to the use of renewable energy in municipalities and the evaluation of the effectiveness of tools and instruments used by municipalities in the development of renewable energy.

Results of the research

Energy generated from renewable sources accounted for 18% of the energy consumed in the power industry, heat supply and transport as of 31.12.2020 (Directive, 2018). Meanwhile, according to the EU plan, energy from renewable sources should account for 20% of the total energy consumption at the end of 2020. Poland, which is supposed to have reached the 15% level by 2020, had achieved 11.8% by the end of 2020 (Figure1).

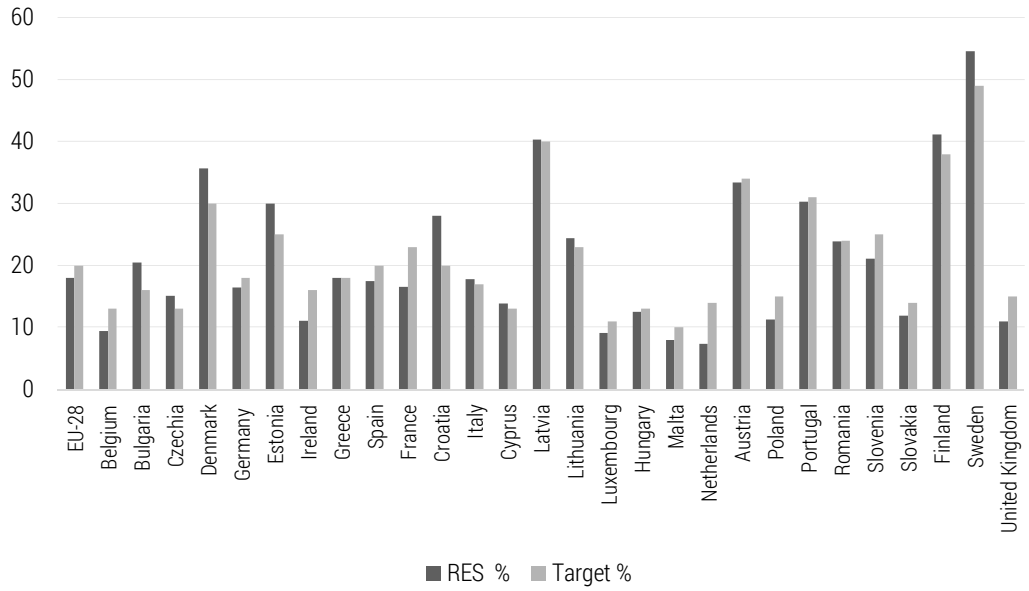

Figure 1. The level of renewable energy (RES) in relation to the 2020 target in EU countries as of 31/12/2020 [%]

Source: Eurostat, 2020.

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The situation has not changed, and even it has been slightly worse for several years. In 2015, energy from renewable sources accounted for 11.7% of the total energy consumed in Poland. It means that the situation regarding energy generation from renewable sources has not changed for several years. Currently, the level of Poland meeting its commitment regarding the share of energy from renewable sources in the national energy mix is decreasing, which, in the future, could result in sanctions imposed by the European Commission. According to the Supreme Chamber of Control (Report on development of renewable energy sources sector Supreme Chamber of Control 2018), neglect in this area can result in billions of PLN of costs to be incurred by Poland. The cost of incomplete accomplishment of the goal of the RES share in the total energy consumption is estimated at PLN 111-120 billion by 2030.

To guarantee the attainment of the 21% share of the RES goal by the end of 2030, Poland should take additional actions immediately aimed at providing incentives to use RES in all sectors. So far, the energy policy of Poland has focused on the attainment of goals associated with energy security, improvement of the sector competitiveness, improvement of the energy efficiency of the economy and restriction of the negative impact on the environment. However, due to the changes and challenges that have appeared in the area of climate and energy in recent years, it has been necessary to update the directions in which actions in the Polish power sector and – indirectly – in the Polish economy should be taken (Ligus, 2010).

The main tasks before the Polish energy policy by 2040 include the optimal use of its own energy resources, expansion of the energy generation and network infrastructure, diversification of oil and gas supplies and growth of the network infrastructure, development of the energy markets, implementation of nuclear power generation, development of the renewable energy sources sector, development of heat generation and cogeneration and improvement of the energy efficiency of the economy pole (Malko, 2009).

The current state of the power sector, the structure and forecasts for energy consumption in the national economy are of critical importance for the development of the renewable energy sector. The decision regarding the coal-based economy is also of great importance – the investments made then have long-term economic, social and territorial consequences. At the same time, international commitments have to be met, and technological progress and general economic development necessitate continuous changes in the sector (Kozłowski, 2016). Energy from renewable sources in Poland includes solar energy, energy generated from wind and water, geothermal energy and energy generated from solid and liquid biofuels and biogas, as well as energy generated with heat pumps. The structure of energy generation from renewable sources is shown in Table 1.

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Table 1. The structure of the installed power of renewable energy in Poland in 2016-2020

Installed power [MW]					
Type of RES	**2016**	**2017**	**2018**	**2019**	**2020**
Biogas power plants	212.5	234.0	235.1	237.6	245.4
Biomass power plants	1,122.7	1,281.1	1,362.0	1,362.8	1,492.9
Solar power plants	71.0	99.1	104.0	147.0	477.7
Wind power plants	4,582.0	5,807.5	5,848.7	5,864.4	5,917.2
Hydroelectric power plants	981.8	994.0	988.4	981.5	973.1
Total	6,970.0	8,415.5	8,538.4	8,593.4	9,106.3
Y to y increase	941.4	445.5	122.8	55.1	512.8

Source: URE, 2021.

Wind power plants, hydroelectric power plants and biomass have the most significant share in the Polish RES market. However, due to the intensive growth of photovoltaics, especially in the micro-installation sector, it can soon become the technology with the second largest (after wind power) share in the RES sector in Poland. Table 1 covers only small photovoltaic installations over 50 kW and those with a licence to sell electricity, which produced a total of nearly 478 MW of power as of 31.12.2020. Meanwhile, the real power of all installations (including prosumer ones) is close to 990.51 MW and is growing steadily. A considerable increase in the interest in photovoltaic micro-installations in recent years is caused by a rapid increase in electricity prices and the price rates used by entrepreneurs. There were 155,189 solar installations making use of solar radiation installed as of 31.12.2020, with a total power of 990.51 MW.

Specifies the areas of commune activities which should be performed with a view to the development of renewable energy sources, e.g.:

- seeking and developing local potentials for energy generation from RES,
- enabling the full use of the available renewable resources, mainly wind, hydroelectric, solar energy, biomass and geothermal energy,
- creating programmes of RES development and propagation, emphasising a coherent system of information and support for investors and local governments,
- creating favourable conditions for using financial resources for RES development,
- defining strategic goals and striving for financial predictability based on strategic planning.

The strategy assumes that the goal of regional policy will be to ensure more sustainable development of the country by integrated interventions

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using local resources and the potential of individual territories and providing sufficient resources for initiation of sustainable growth and creating jobs in areas where conditions are less favourable to development (A European strategy, 2006).

In the first stage of the study, the annual average electricity and heat consumption by communes was analysed, and the energy consumption for a commune's needs was determined. The energy consumption by communes under study in 2020 was estimated to amount to 23,469,801 MWh. The largest amounts of energy are consumed by urban-rural communes (48 communes): 16,173,597 MWh of electricity and 7,907,975 MWh of heat. Rural communes consume 55% less electricity and 46% less heat than urban-rural communes (Table 2).

Table 2. Energy consumption in the communes under study – 2020 data

Type of commune	Number of communes	Population	Area [km^2]	Consumption of electricity in communes [MWh]	Consumption of heat in communes [MWh]	Consumption of electricity by communal resources [MWh]	Consumption of heat in communes [MWh]
Rural	52	352,485	9991	7,296,203	3,668,417	511,005	204,495
Urban-rural	48	995,263	13594	16,173,597	7,907,975	1,182,126	578,756
Total	100	1,347,748	23585	23,469,801	11,576,392	1,693,131	783,251

Source: Local Data Bank, 2021.

It is a research problem that the amount of electricity and heat consumed by communes may vary from one year to another, which may be a consequence of atmospheric conditions and actions taken by the entities aimed at reducing the energy consumption. The annual average electricity consumption by one urban and one rural commune in 2020 amounted to 336,950 MWh, and a rural commune consumed 140,312 MWh on average. An urban-rural commune consumed an annual average of 164,750 MWh of heat, and a rural commune consumed 70,546 MWh. A comparison of the average yearly energy consumption in the communes of the Voivodship of Warmia and Mazury shows that the rural communes consume less electricity and heat by an average of 40% than the urban-rural communes (Table 3). Both the urban-rural communes and rural communes use an average of 7% of the total electricity and heat consumption to satisfy their own needs. In 2020, the rural communes needed 9,827 MWh of electricity and 3,933 MWh of heat to satisfy their needs. The urban-rural communes needed 24,628 MWh of electricity and 2,057 MWh of heat. This is similar regarding the consumption of electricity and heat by the commune, where the rural communes need 60% less electricity and 67% less heat than the urban-rural communes (Table 3).

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Table 3. Annual average consumption of energy in communes of the Warmia and Mazury Voivodeship in 2020 [MWh/commune/year]

Type of commune	Quantity	Average consumption of electricity	Average consumption of heat	Average consumption of electricity by communal resources	Average consumption of heat by communal resources
Rural	52	140,312	70,546	9,827	3,933
Urban-rural	48	336,950	164,750	24,628	12,057
Total	100	477,262	235,296	34,455	15,990

Source: Local Data Bank, 2021.

The annual consumption of renewable energy in the communes of the Voivodship of Warmia and Mazury is estimated to amount to 991,115 MWh, which accounts for 4% of the total energy consumption in the Voivodship. The consumption differs from the national data, according to which the consumption of energy from renewable sources in the Voivodship of Warmia and Mazury is 10.7%. This may arise from the method of measurement of the difference between the installed power and that actually used. The wind is the dominant source of renewable energy in the Voivodship, accounting for 58% of all the energy from RES. Geothermal energy accounts for the smallest portion of energy from RES – 1.5% (Table 4).

Table 4. Consumption of energy from renewable sources in the communes of the Voivodship of Warmia and Mazury [MWh/year]

Voivodship of Warmia and Mazury	Wind energy	Energy from photovoltaics	Energy from biomass	Energy from biogas	Geothermal energy	Hydroelectric energy
Communes	580,000	37,800	198,760	111,400	14,375	49,177
Total	991,115					

Source: Local Data Bank, 2021.

An analysis of renewable energy source locations in the Warmia and Mazury Voivodeship shows that the largest number of communes (92) have photovoltaic installations in their areas. Wind energy and biomass installations can be found in 70 communes. Biogas installations can be found in the smallest number of communes – 11 (Table 5). When conducting the study by the survey method, the officials found it difficult to determine the amount and the size of the installation because of the lack of formalised knowledge of this matter as well as frequent changes in regulations regarding issuing permits for RES installations. This issue requires further studies.

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Table 5. The number of communes in which energy from renewable sources (RES) is used

Type of commune	Wind energy	Energy from photovoltaics	Energy from biomass	Energy from biogas	Geothermal energy	Hydroelectric energy
Rural	32	44	36	5	13	28
Urban-rural	38	48	34	6	26	24
Total	70	92	70	11	39	52

Source: Local Data Bank, 2021.

The largest number of communes (77) use photovoltaic energy to satisfy their own needs. Only four communes use wind energy and energy from biomass. The communes practically do not use energy from biogas, hydroelectricity or geothermal energy to satisfy their needs (Table 6). Local boiler houses and small photovoltaic installations, e.g., bus stops, local lighting, etc., are the most common ways of using energy from renewable sources.

Table 6. The number of communes using RES to satisfy their own needs

Type of commune	Wind energy	Energy from photovoltaics	Energy from biomass	Energy from biogas	Geothermal energy	Hydroelectric energy
Rural	0	34	1	0	0	0
Urban-rural	4	43	3	0	0	0
Total	4	77	4	0	0	0

Source: Local Data Bank, 2021.

Local communal initiatives aimed at acquiring energy from renewable sources are also an essential issue in energy policy. According to the study findings, the communes consume 80,105.09 MWh for their needs, which accounts for 8% of the total energy from renewable sources generated in the Voivodship of Warmia and Mazury (Table 7).

Table 7. Amount of energy from RES consumed by the communes for their own needs [MWh/year]

Type of commune	Wind energy	Energy from photovoltaics	Energy from biomass
Rural	0	12,101.9	306.7
Urban-rural	14,902.5	50,831.1	1,962.9
Total	80,105.1		

Source: Local Data Bank, 2021.

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Energy from photovoltaics is the primary type of energy from renewable sources consumed for the communes' needs (79% of the total energy from renewable sources consumed by the communes). Photovoltaic installations are used by communes mainly in small infrastructure objects, such as bus stops, individual technical infrastructure buildings, etc. The communes use facilities that enable energy generation from biomass, mainly in local boiler houses. Energy from renewable sources is consumed mainly by commune institutions such as schools, kindergartens, commune offices, etc. Having a RES development strategy or plan is one of the key issues for renewable energy industry development in the communes. The study found that 83 communes have no RES development strategy in their areas, and, in consequence, they do not have any analyses of the RES potential or the possibility of its use in their areas (Table 8). This limits RES usability by the communes. This study has shown that the communes mistake the "Plan for energy and gas supply to the commune", which is an administrative document rather than a strategic one, for a "RES development strategy". The number of communes that have RES development strategies in their areas is shown in Table 8.

Table 8. The number of communes that have RES development strategies

Type of commune	With RES development strategies in place	Without RES development strategies in place
Rural	1	51
Urban-rural	16	32
Total	17	83

Source: author's work.

All of the 32 urban-rural communes which did not have an RES development strategy in place expressed their interest in developing one, with support from external specialists. Only 38 were interested in preparing such a document, while 13 saw no sense in doing so (Table 9).

Table 9. Communes' interest in preparing an RES development strategy

Type of commune	The number of communes interested in preparing an RES development strategy	The number of communes not interested in preparing an RES development strategy
Rural	38	13
Urban-rural	32	0
Total	70	13

Source: author's work.

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The communes' implementation of the energy policy adopted by the EU with respect to energy from renewable sources included various actions taken by communes, with the thermal improvement of buildings in the commune (97 communes took actions in this area). Thermal improvement contributed to a decrease in energy consumption, encouraging owners to modernise their energy sources. Subsequently, communes acquired funds from EU programmes for the power industry (95 communes acquired such funds) and made investments in RES (92 communes). Detailed data are shown in Table 10.

Table 10. Communes' actions in the RES area

Type of commune	Thermal improvement	Investments in RES	Acquiring funds from EU	Educating the population	Other
Rural	49	45	48	34	6
Urban-rural	48	47	47	35	7
Total	97	92	95	69	13

Source: author's work.

Studies regarding the benefits the communes perceive with respect to RES development give varied findings. The most significant number of communes (78) see benefits for the environment. This is associated mainly with meeting the constantly growing challenges set by the EU regarding the environment, as well as improvement of the quality of life, with the improvement of the air, soil and water quality as its manifestations. Further, communes see RES development as a factor that brings them economically (64 communes) and social (63 communes) benefits. The former involves the stimulation of demand for goods and services in the local markets. Social benefits apply perceptible improvement of the population's health and quality of life. As much as 25% of the communes under study see no benefits from RES development in their area, which may result mainly from the specific nature of the communes and the RES potential at their disposal (Table 11).

The study involved the communes defining the most frequently occurring barriers that they have to overcome in the process of RES development in their area. These include legislation regarding environmental protection (87 communes) with the accompanying legal restrictions (74 communes). The defined barriers to RES development are a consequence of the changing legal environment and constantly growing environment-related requirements from the EU. Moreover, the environmental protection legislation applies to the area of 1,122,000 km^2 in the Voivodship of Warmia and Mazury,

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which accounts for 46.7% of the voivodship area. A smaller number of communes mentioned financial barriers associated with acquiring capital (57 communes) as well as social barriers (57 communes) involving public resistance to the construction of RES installations, mainly wind farms (Table 12).

Table 11. Benefits from RES development as seen by the communes

Type of commune	Benefits							
	Economic	Social	Environmental	Promotion of communes	Tourism development	New jobs	Other	No benefits
Rural	29	28	37	18	16	19	12	9
Urban-rural	35	35	41	32	23	24	9	16
Total	64	63	78	50	49	43	21	25

Source: author's work.

Table 12. The most frequently occurring barriers associated with RES development

Type of commune	Barriers				
	financial	legal	environmental	social	not known
Rural	32	37	44	26	10
Urban-rural	25	37	43	31	9
Total	57	74	87	57	19

Source: author's work.

As part of the study, the communes listed the types of activities which would contribute to RES development in their areas. The largest number of communes (75) would like to cooperate with the University of Warmia and Mazury and organise training sessions on this subject matter. Another activity that the communes would like to pursue is the cooperation with external experts (69 communes), who could prepare a strategy, conduct training sessions, and open consultations for an RES investment. The smallest number of communes (13) consider so-called "other actions" (otherwise not classified), and 34 communes see potential benefits in establishing energy cooperatives (Table 13).

Studies have also shown that the main obstacle that the communes under study have to overcome is insufficient knowledge of energy from renewable sources, which independent local government entities cannot acquire. This is why various initiatives are recommended, such as organising symposiums and scientific conferences and establishing cooperation with scientific centres and public benefit institutions.

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Table 13. Communes' actions aimed at more effective use of RES in the communes

Type of commune	Communes' activities							
	Seminar/ Conference	RES development programme	Cooperation with an expert	Establishing cooperation with UWM	Training on RES	Assis-tance in acquiring EU funds	Establishing energy cooperatives	Other
Rural	14	25	32	35	36	24	18	6
Urban-rural	15	26	37	40	39	30	16	7
Total	29	51	69	75	75	54	34	13

Source: author's work.

Conclusions

Development of renewable energy generation slowed down between 2016 and 2020, which may result in a failure to meet the EU goals for the level of renewable energy in total energy consumption. The relative cost-effectiveness of different energy generation technologies will have changed by 2030. In particular, the cost of energy generation from coal will increase. The development of wind and photovoltaic installations, particularly prosumer energy generation, will require assistance – not only financial assistance but also as part of the regional policy.

The accomplishment of the long-term goal of an increase in the share of renewable energy sources in the total energy consumption depends largely on the use of local energy potentials. This, in turn, depends on the activity and usage of different kinds of instruments of renewable energy development by communes. A study of the application of renewable energy development support instruments in 100 communes of the Voivodship of Warmia and Mazury indicated the following:

- renewable energy had a 4% share in the total energy consumption in the Voivodship of Warmia and Mazury as of 31.12.2020,
- 8% of the total renewable energy generated in the Voivodship of Warmia and Mazury during the period under study was consumed to satisfy the communes' own needs,
- photovoltaics is the basic renewable source used to generate energy for the communes' own needs, and this energy accounts for 79% of the total renewable energy consumed for the communes' own needs,
- 83% of the communes under study do not have a renewable energy development strategy in their area, but they are interested in preparing one,

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- thermal improvement and acquiring funds for micro-investments are the most common actions aimed at saving and acquiring new energy sources by communes,
- the main benefits that local governments see in renewable energy development are environmental benefits associated with improvement of the quality of life in the area,
- the main barriers seen by the most significant number of local governments include environmental acts and constantly changing EU legislation,
- the communes see opportunities for renewable energy development mainly in cooperation with the University of Warmia and Mazury and in training in these matters, as well as in cooperation with an external expert.

Studies have confirmed that there is still great untapped potential for supporting the communes in developing a strategy of renewable energy development, both in legal matters and practically.

Environmental considerations are the basic determinant in investment in renewable energy in the Voivodship of Warmia and Mazury. The lack of a strategy for renewable energy development in most communes is a barrier to making use of its potential. Because of different legal interpretations and social attitudes, there is a need to conduct and publicise in-depth analyses, especially regarding the environmental impact of renewable energy installations. Energy-related planning should be more highly correlated with spatial planning as an important instrument for the planning and developing of renewable energy. In particular, communes should establish zones for wind energy and see to it that waste and regional biomass resources are made use of. Prosumer energy generation should also be supported.

Proposals for practical activities of the commune in the field of development of renewable energy installations in the current legal status concerning both the functioning of communes and renewable energy sources:

- organise an Agency for Renewable Energy in the commune to support local communities in terms of promotion and organisational support in obtaining EU funds for renewable energy,
- to organise energy clusters by the commune to implement investment projects in the field of renewable energy installations,
- establishment of energy cooperatives associating entities related to the production and distribution of renewable energy in order to develop a strategy for the development of renewable energy,
- initiation of the Smart grid model consisting in the use of smart energy grids using renewable energy resources in the first place, which also enables, in a strategic perspective, optimisation of energy costs for the local community and business, investment inflow and job growth. Renewable

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energy can provide an essential stimulus for the socio-economic development of communes in the Voivodship of Warmia and Mazury.

Social challenges and directions of activities related to the development of renewable energy in the commune should take into account: social aspects of energy transformation, social dialogue and effective communication, solidarity and joint responsibility of residents and authorities, strengthening cooperation and synergy of activities in the commune (Worek et al., 2021).

Energy is an essential factor in promoting sustainable development. Many countries strive to achieve this goal, create a new concept of energy development and evaluate their energy systems in terms of compliance with the goals of sustainable development. However, effective use of renewable energy resources requires the cooperation of all the entities concerned, especially local governments and scientific institutions, with a view to preparing detailed analyses of locations for renewable energy installations. It would be justified to establish a Warmia and Mazury Renewable Energy Agency to deal with organisational and analytical issues associated with using energy resources.

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