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**SUPPORTING INVESTMENTS IN THE PRODUCTION
AND DISTRIBUTION OF ENERGY FROM RENEWABLE
SOURCES IN THE KUJAWSKO-POMORSKIE PROVINCE
– A CASE STUDY OF THE BOROUGH OF KĘSOWO**

Key words: renewable energy sources, energy security, sustainable development,
Borough of Kęsowo, support for RES installations

ABSTRACT. The purpose of the study was to present issues in the field of supporting the production and distribution of energy from renewable sources, especially photovoltaic systems, in Kęsowo Borough. Energy from renewable sources enables energy efficiency and security to increase. In 2018, the Marshal's Office in Toruń carried out activities supporting the production and distribution of energy from renewable sources as part of the Regional Operational Programme of the Kujawsko-Pomorskie Province. One of the beneficiaries that obtained information on the demand for RES from the inhabitants of the Province was the rural Kęsowo Borough. Research employed the *desk research* analysis method. Analysis of subject literature and data from the Borough Office of Kęsowo facilitated establishing facts, verifying data and presenting results. 41 residents of Kęsowo Borough took advantage of the opportunity to support investments in renewable energy, including photovoltaic installations, solar collector installations and air heat pumps. Research has shown that the Borough did not fully utilise the available pool of funds, while the photovoltaic installations with the requested average power of 5.22 kW enjoyed the greatest interest.

INTRODUCTION

The depletion of conventional energy sources imposes a search for alternative carriers and fuels to prevent an energy crisis. Due to progressing climate change, any new solutions must comply with the principles of sustainable development [Wielewska, Zuzek 2015]. One of the key assumptions of this development is care for the natural environment. This is favoured by investments in renewable energy sources, which are understood as “primeval energy perceived as inexhaustible from the human time horizon” [Reichel, Czambor 2013, p. 574]. “RES are renewable, non-fossil energy sources including wind energy, solar radiation energy, aerothermal energy, geothermal energy, hydrothermal energy, hydropower, energy of sea waves, currents and tides, energy obtained from biomass, biogas, agricultural biogas and bioliquids” [Journal of Laws, 2015.478, 2365 as amended]. The advantage of these sources is more efficient and less harmful energy production and distribution as well as the maintenance of homeostasis between: energy security, satisfying social needs,

competitive management and environmental protection. “Energy from renewable sources is gaining more and more applications, because it is perceived as ecologically ‘clean’ and compliant with the principles of sustainable development” [Wielewska et al. 2018, p. 378].

As a member of the EU, Poland is obliged to achieve specific goals of EU climate and energy policies, which are implemented at governmental and local authority levels. The overall goal pursued by the Polish energy policy is to achieve a 15% share of energy obtained from renewable energy sources and reduce greenhouse gas emissions by 20% by 2020 [Graczyk et al. 2017]. Currently, it is the boroughs – the basic units of local government – that are obliged to plan and organize the supply of heat, electricity and gaseous fuels, as well as undertake measures to rationalize energy consumption and promote solutions that reduce energy consumption [Journal of Laws, 1997.54.348]. Boroughs and communes are increasingly willing to take part in renewable energy activities and benefit from various EU programmes that support investment in the production and distribution of energy from renewable sources. One of the boroughs that has collected information from property owners regarding the demand for RES installations and submitted an application for co-financing was the rural commune of Kęsowo.

The aim of the paper was to present issues in the field of supporting the production and distribution of energy from renewable sources, photovoltaic systems in particular, in the borough of Kęsowo. For this purpose, an analysis of applications was carried out, taking the type of RES installation, its capacity, costs and place of residence of beneficiaries into account. Since the photovoltaic installation enjoyed the greatest interest, the estimated costs of its installation were indicated, as well as the calculation of time needed for its repayment without financing and in the case of using financial assistance, with two options of installation location, i.e. on a residential building or on an outbuilding or land area) and the related VAT rate (8% and 23%, respectively).

MATERIAL AND METHODS

The call for applications for funding from the Regional Operational Programme of the Kujawsko-Pomorskie Province for 2014-2020 was announced by the Marshal’s Office of the Kujawsko-Pomorskie Province in Toruń from August 20 to December 14, 2018 (contest no. RPKP.03.01.00- IZ.00-04 -212/18) under Priority Axis 3 “Energy efficiency and low-carbon economy in the region”, under Measure 3.1 “Support for the production and distribution of energy from renewable sources, scheme: Micro-installations, scheme 1: residential and public buildings (excluding healthcare infrastructure)”. The applicants entitled to submit an application for co-financing included: local government units, cooperatives and housing associations as well as social housing associations and non-governmental organizations. The maximum amount of funding requested was no more than PLN 1 million. [Wielewska, Zająkała 2019, Zielińska 2019].

The research used the desk research analysis method. Analysis of subject literature and data from the Borough Office of Kęsowo facilitated establishing facts, verifying data and presenting results. The study was conducted on the basis of data from the application for co-financing of renewable energy support activities submitted by the local government unit – Kęsowo Borough, a rural commune located in the Kujawsko-Pomorskie Province, in

Tuchola County, with an area of 108.8 km². According to population statistics as of June 30, 2019, the Borough's area is inhabited by 4,505 people, including two foreigners. The Borough is made up of 19 localities situated in 10 village communes [Portal of Kęsowo commune, www.kesowo.pl]. Most people are registered in Żalno (938 inhabitants), Kęsowo (851 people) and Piastoszyn (537 people). Adamkowo, Ludwichowo and Sicinki are the smallest localities with populations counting less than 50 inhabitants. Table 2 presents the population in Kęsowo Borough.

The application for co-financing under Measure 3.1 was drawn up by the Borough Office of Kęsowo on the basis of data obtained from residents – household owners in the commune (final beneficiaries) interested in the installation of devices for the production of energy from renewable sources and possessing the technical design of the installations requested. The subsidy was intended for natural persons from the area of Kęsowo Borough, and renewable energy installations could only be used to satisfy the needs of households (it did not include business or agricultural activities). Residents could apply for the installation of photovoltaic installations, air heat pumps, solar collectors and pellet boilers. The maximum cost for such an investment for a natural person was up to PLN 100,000. Based on average electricity bills, the rated capacity of the planned RES installation was determined. In addition to the residential building, renewable energy installations could be designed on other buildings, but only those that were property of the applicant. The choice of the location for the RES installation was related to the VAT rate. The tax for renewable energy installations designed on or in a residential building was 8%, and the ones designed on or in an outbuilding or on the surface of the land – 23%. Property owners could apply for funding of up to 50% of net eligible costs incurred [Zielińska 2019]. The extent of the co-financing was calculated by multiplying the amounts of the level of net costs incurred and the maximum level of return. According to the data of the Borough Office of Kęsowo, the total amount of co-financing, including VAT rates, was about 48% for RES installations within a residential building, and about 44% on the land or an outbuilding.

The beneficiaries of Kęsowo Borough were most interested in the set-up of a solar, or photovoltaic installation (PV).

Solar energy is undoubtedly a free and clean source of energy. It can be converted into electricity and heat. For electricity production, sun rays can be used in both direct and indirect form. The first method uses solar radiation to heat water and indirectly produce electricity. It is mainly used on a large scale, i.e. in solar power plants. The second method involves the direct transformation of sunlight into electricity using photoelectric transducers. These are e.g. solar cells [Piech et al. 2019]. According to Rafał Krakowski [2014], these installations are becoming more and more popular in Europe, and the total power of new installations mounted on the roofs of commercial and residential buildings and on the ground increases every year. In addition, the decrease in prices of equipment intended for PV, the annual increase in electricity costs and the possibility of obtaining funding result in the shortening of payback time and much more.

In the study, the period of the PV return-on-investment time was also analyzed. For this purpose, data obtained from the Borough Office of Kęsowo concerning the net costs of the installation, the demand for its power and energy costs were used (Table 1).

Table 1. Cost of solar installation depending on its power

No.	Cost of electricity [PLN/month]	Power of the photovoltaic installation [kW]	Net cost of installation netto [PLN]	Gross installation cost (8% VAT) [PLN]	Gross installation cost (23% VAT) [PLN]
1.	100	2.32	8,120.00	8,769.60	9,987.60
2.	125	2.9	10,150.00	10,962.00	1,248.50
3.	150	3.19	11,165.00	12,058.20	13,732.95
4.	175	3.48	12,180.00	13,154.40	14,981.40
5.	200	3.77	13,195.00	14,250.60	16,229.85
6.	225	4.06	14,210.00	15,346.80	17,478.30
7.	250	4.35	15,225.00	16,443.00	18,726.75
8.	275	4.64	16,240.00	17,539.20	19,975.20
9.	300	4.93	17,255.00	18,635.40	21,223.65
10.	325	5.22	18,270.00	19,731.60	22,472.10
11.	350	6.09	21,315.00	23,020.20	26,217.45
12.	375	6.67	23,345.00	25,212.60	28,714.35
13.	400	8.12	28,420.00	30,693.60	34,956.60
14.	425	8.99	31,465.00	33,982.20	38,701.95
15.	450	9.86	34,510.00	37,270.80	42,447.30

Source: own study based on the data of the Borough Office of Kęszowo

Beneficiaries were required to submit a technical design including the planned capacity of the installation, the size of which was determined on the basis of average electricity consumption during the year. Applications could be submitted for installations with the planned power level within a range of 1.74-9.86 kW. None of the farms in Kęszowo Borough reported a demand for an installation with a capacity of 1.74 kW. The smallest photovoltaic installation power applied for by property owners was 2.32 kW. It was chosen by those households with annual costs of electricity amounting to ~PLN 1,200. Applications for installations with the highest power available in the programme, i.e. 9.86 kW, were submitted by household owners with annual costs of electricity amounting to ~PLN 5,400.

A comparative analysis was also conducted concerning the return-on-investment time if the investment was financed from own funds and in the case of using co-financing, considering the location of the installation and the VAT rate. For installations carried out within a residential building, an 8% VAT rate was used, and for those within a utility outbuilding or on land – a 23% VAT rate. The period of return for the investment made without co-financing was calculated by dividing gross costs by the value of monthly electricity bills. In turn, the return period for the investment made with a share of public funds was calculated on the basis of the quotient of own contribution and the sum of electricity bills for one month. Therefore, the subsidy amount was first calculated by multiplying the net cost x 50%, and then this amount was deducted from gross costs including 8%

and 23% VATs. The costs obtained were then divided by the amount of electricity bills incurred for one month.

RESEARCH RESULTS AND DISCUSSION

The total eligible cost of the analyzed undertaking in Kęsowo Borough was PLN 1,217,276.64 net. About 50% of the eligible costs was covered by subsidies obtained from EU funding. In the call for Measure 3.1 “Supporting the production and distribution of energy from renewable sources”, the residents of 41 households of Kęsowo Borough submitted applications for the purchase and installation of 53 RES micro-installations with a total capacity of 225.24 kW, including 2 solar collector installations with a total capacity of 7.98 kW, 18 air heat pumps with a total power of 45 kW and 33 photovoltaic installations with a total power of 172.26 kW.

As part of the project, Kęsowo Borough also applied for the co-financing of 8 installations in 5 public buildings, including 5 photovoltaic installations with a total power of 95.12 kW and 3 pellet boiler installations with a total heat output of 110 kW. Research did not include a detailed analysis of data from applications, where it was planned to set up installations on/in public buildings.

Detailed data on the type of renewable energy installations, the number of applications submitted by Borough residents, including the place of residence of beneficiaries is presented in Table 2.

Beneficiaries applying for financial aid for the purchase and installation of RES installations were residents of 8 out of 10 villages of Kęsowo Borough. The percentage of applications submitted per one inhabitant of the commune was 0.009. The largest number of applications was submitted in the two most populated villages of Żalno and Kęsowo. The owners of real estate located in the village of Żalno applied for the co-financing of 16 RES installations, and another 14 applications were submitted in Kęsowo. The residents of the village of Jeleńcz applied for funds for three RES installations, and one of those applications was submitted in each of the remaining 8 localities. Two villages – Grochowo and Piastoszyn did not plan to purchase or install any renewable energy installations in their area.

Photovoltaic installations were the most popular (as much as 62.26%) with a total power of 172.26 kW (Table 3). Some renewable energy installations, with the lowest requested power of 2.32 kW, are planned for one residential building in Jeleńcz and two buildings in Kęsowo. There were three residents from Jeleńcz, Brzuchowo and Obrowo who applied for a solar installation with a maximum capacity of 9.86 kW with co-financing. The largest number of applications still concerned photovoltaic installations with a rated power of 4.64 kW, for which 5 residents applied: one from Adamkowo and four from Kęsowo.

In the surveyed commune, the demand for renewable energy installations with a total capacity of 225.24 kW was declared, including as much as 172.26 kW allocated for photovoltaic panels. The average energy demand from this type of installation was 5.22 kW (Table 3). The return-on-investment period for the installation of photovoltaic panels with the use of public funds was, on average, 34 months shorter than in the case of RES installations without co-financing, both for installations set up within a residential building and on outbuildings or on the ground (Table 4).

Table 2. The number of applications for Activity 3.1 submitted by residents of Kęsowo Borough

No.	Place of residence of beneficiaries	Village borough	Number of		Total installation power [kW]			Required number of		
			residents	applications submitted	electrical	heat	heat pumps	photovoltaic installations	solar collector installations	
1.	Drożdżenica	Drożdżenica	372	1	4.35	0	0	1	0	
2.	Ludwichowo		33	0	0	0	0	0	0	
3.	Grochowo	Grochowo	66	0	0	0	0	0	0	
4.	Jeleńcz	Jeleńcz	173	3	17.40	7.82	1	3	1	
5.	Tuchółka		211	0	0	0	0	0	0	
6.	Kęsowo		851	14	62.35	7.50	3	13	0	
7.	Sicinki	Kęsowo	20	0	0	0	0	0	0	
8.	Siciny		55	0	0	0	0	0	0	
9.	Obrowo	Obrowo	142	1	9.86	2.50	1	1	0	
10.	Adamkowo	Pamiętowo	40	1	4.64	0	0	1	0	
11.	Pamiętowo		207	1	0	2.50	1	0	0	
12.	Piastoszyn	Piastoszyn	537	0	0	0	0	0	0	
13.	Przymuszewo	Przymuszewo	177	1	0	2.50	1	0	0	
14.	Krajenki		133	0	0	0	0	0	0	
15.	Wieszczyce		281	1	4.35	2.50	1	1	0	
16.	Bralewnica	Wieszczyce	66	1	8.12	0	0	1	0	
17.	Brzuchowo		124	1	9.86	2.50	1	1	0	
18.	Żalno		938	16	51.33	25.16	9	11	1	
19.	Nowe Żalno	Żalno	79	0	0	0	0	0	0	
Total		10	4,505	41	172.26	52.98	18	33	2	

Source: own study based on the data of the Borough Office of Kęsowo

Table 3. Data on photovoltaic installations requested by residents of Kęsowo Borough

No.	Rated power [kW]	Number of panels [pcs]	Number of applications	Total power of photovoltaic installations [kW]	Total number of panels [pcs]
1.	2.32	8	3	6.96	24
2.	2.9	10	1	2.90	10
3.	3.19	11	2	6.38	22
4.	3.48	12	1	3.48	12
5.	3.77	13	1	3.77	13
6.	4.06	14	3	12.18	42
7.	4.35	15	4	17.40	60
8.	4.64	16	5	23.20	80
9.	4.93	17	2	9.86	34
10.	5.22	18	2	10.44	36
11.	6.09	21	1	6.09	21
12.	6.67	23	1	6.67	23
13.	8.12	28	3	24.36	84
14.	8.99	31	1	8.99	31
15.	9.86	34	3	29.58	102
Total			33	172.26	594

Source: own study based on the data of the Borough Office of Kęsowo

Thanks to the analysis conducted, it was possible to ascertain that the longest return-on-investment period applied to the 2.32 kW and 2.90 kW solar installations. In the case of investment implemented exclusively from private funds, the return-on-investment was between 88 and 100 months, depending on the place of installation, i.e. after 7.3-8.3 years of installation use. However, in the event of subsidies, the return period of incurred costs will significantly be shortened and will amount to 4-5 years.

The repayment period for other renewable energy installations is even shorter. The 5.22 kW installation, which covers monthly energy bills of PLN 325, proved to be the most economical investment. In the case of this installation on a residential building, the return period of incurred costs will be 2 years and 7 months, and if it is installed on another building or on the ground, this period will be slightly over 3 years. The return period for the same installation, but without obtaining public financial aid, will extend to 5 years for installations within a residential building and 5.7 months if the installation is set up on another building or on the ground [see Wielewska, Zająkła 2019].

Table 4. Average return-on-investment period for a photovoltaic installation mounted on a residential building (VAT 8%), on an outbuilding or the ground (VAT 23%) without subsidies and with co-financing

No.	Installation power [kW]	Investment implemented [months]			
		without subsidy (VAT 8%)	without subsidy (VAT 23%)	with co-financing (VAT 8%)	with co-financing (VAT 23%)
1.	2.32	87.70	99.88	47.10	59.28
2.	2.90	87.70	99.88	47.10	59.28
3.	3.19	80.39	91.55	43.17	54.34
4.	3.48	75.17	85.61	40.37	50.81
5.	3.77	71.25	81.15	38.27	48.16
6.	4.06	68.21	77.68	36.63	46.10
7.	4.35	65.77	74.91	35.32	44.46
8.	4.64	63.78	72.64	34.25	43.11
9.	4.93	62.12	70.75	33.36	41.99
10.	5.22	60.71	69.14	32.60	37.89
11.	6.09	65.77	74.91	35.32	44.46
12.	6.67	67.23	76.57	36.11	45.44
13.	8.12	76.73	87.39	41.21	51.87
14.	8.99	79.96	91.06	42.94	54.05
15.	9.86	82.82	94.33	44.48	55.98
Average		73.02	83.16	39.22	49.15

Source: own study based on the data of the Borough Office of Kęsowo

On the other hand, the cost of the installation with maximum power, i.e. 9.86 kW, with support financing and assembly within a residential building is reimbursed after 3 years and 7 months, and for installations on other buildings or on the ground – after 4 years and 7 months. In the absence of co-financing, this period will extend to 6 years and 9 months for installations on residential buildings, and one more year for installations in other permitted locations.

In Kęsowo Borough, other RES installations enjoyed much less interest compared to photovoltaic installations. 18 applications were submitted for air heat pumps with a capacity of 2.5 kW each, which covers the daily demand for domestic hot water (on average 300 l) for 3-5 permanent residents of the household. Nine applications were submitted in Żalno, 3 in Kęsowo and one in each of six smaller villages of Kęsowo Borough. In addition, the residents of the Borough also demanded two solar collector installations. The beneficiary of one of the two applications was a resident of Żalno and the other a resident of Jeleńcz. The average requested solar power was 3.99 kW.

CONCLUSIONS

1. The rural commune of Kęsowo carried out activities for renewable energy sources, but only used half of EU funds allocated for this purpose.
2. The opportunity to support investments aimed at the production and distribution of energy from renewable sources was most frequently seized by residents of two villages: Kęsowo and Żalno. The residents of two villages – Grochowo and Piastoszyn did not take advantage of this option.
3. Photovoltaic installations (62.26%), with an average requested power of 5.22 kW, enjoyed the greatest interest amongst the inhabitants of Kęsowo Borough. Other micro-installations were chosen much more rarely (33.96% of heat pumps and 3.77% of solar collectors).
4. The return-on-investment period for investments made with the use of public funding was on average 34 months shorter than in the case of RES installations without funding. The shortest return time needed to repay the investment concerned a 5.22 kW installation and amounted to 2 years and 7 months for an installation within a residential building, and slightly more than 3 years for installations on out buildings or on the ground.
5. The longest payback period concerned installations with the lowest power, i.e. 2.32 kW and 2.90 kW. Applicants who requested such capacities spent about PLN 1,200-1,500 annually on electricity bills.

BIBLIOGRAPHY

- Graczyk Andrzej, Izabela Wielewska, Małgorzata Piaskowska-Silarska. 2017. *Rozwój odnawialnych źródeł w Polsce. Problemy bezpieczeństwa energetycznego i lokalnego wykorzystania zasobów* (Development of renewable sources in Poland. Problems of energy security and local use of resources). Warszawa: Texter.
- Krakowski Rafał. 2014. Fotowoltaika szansą dla region (Photovoltaic as a chance for region). *Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania. Uniwersytet Szczeciński* 37 (3): 85-93.
- Piech Krzysztof, Paweł Dybowski, Jarosław Kozik, Edmund Ciesielka, Tomasz Siostrzonek, Waldemar Milej, Jakub Wójcik, Michał Rad, Tomasz Lerch, Tomasz Drabek. 2019. Fotowoltaika – tendencje i prognozy (Photovoltaic plant – trends and forecasts). *Maszyny Elektryczne. Zeszyty Problemowe* 2 (122): 57-62.
- Portal gminy Kęsowo (Portal of the Kęsowo commune). https://www.kesowo.pl/index.php?option=com_content&view=featured&Itemid=435, access: 29.11.2019.
- Reichel Markus, Friedrich Czambor. 2013. Odnawialne źródła energii. [In] *Zintegrowane zarządzanie środowiskiem. Systemowe zależności między polityką, prawem, zarządzaniem i techniką* (Renewable energy sources. [In] Integrated environmental management. System relations between politics, law, management and technology), ed. Andrzej Kryński, Matthias Kramer, Aime F. Caekelbergh, 571-596. Warszawa: Wolters Kluwer.
- Ustawa z dnia 20 lutego 2015 r. o odnawialnych źródłach energii* (Act of 20 February 2015 on renewable energy sources). Journal of Laws, 2015.478, 2365 as amended).
- Ustawa z dnia 10 kwietnia 1997 r. Prawo energetyczne* (Act of 10 April 1997 Energy Law). Journal of Laws, 1997.54.348.

- Wielewska Izabela. 2016. Position of energy obtained from agricultural biogas in sustainable power industry. [In] Economic science for rural development. *Proceedings of the International Scientific Conference "Integrated and Sustainable Regional Development Production and Co-operation in Agriculture"* 42: 179-185. Jelgava: Latvia University of Agriculture.
- Wielewska Izabela, Aleksandra Płonka, Adam Kupczyk. 2018. Renewable energy and its impact on the development of rural areas. [In] *Proceedings of the International Conference "Economic Science for Rural Development"* 47: 377-385. Jelgava: Latvia University of Agriculture.
- Wielewska Izabela, Monika Zająkała. 2019. Supporting generation and distribution of energy originating from renewable sources in Kujawsko-pomorskie Province. [In] *Proceedings of the International Conference "Economic Science for Rural Development"* 50: 233-240. Jelgava: Latvia University of Agriculture.
- Wielewska Izabela, Dagmara Zuzek. 2015. Making investment in renewable energy on the level of the borough. [In] *Regional development and its determinants*, ed. Jan Polcyn, Piotr Głowski. 81-90. Piła: Wydawnictwo PWSZ w Pile.
- Zielińska Magdalena. 2019. *Działanie 3.1. Wspieranie wytwarzania i dystrybucji energii pochodzącej ze źródeł odnawialnych (konkurs nr RPKP.03.01.00-IZ.00-04-212/18)* (Action 3.1. Supporting the production and distribution of energy from renewable sources (competition no. RPKP.03.01.00-IZ.00-04-212/18), www.mojregion.eu/index.php/rpo/zobacz-ogloszenia-?mmid=258, access: 09.11.2019.

WSPIERANIE INWESTYCJI DOTYCZĄCYCH WYTWARZANIA I DYSTRYBUCJI ENERGII Z ODNAWIALNYCH ŹRÓDEŁ W WOJEWÓDZTWIE KUJAWSKO-POMORSKIM

Key words: odnawialne źródła energii, bezpieczeństwo energetyczne, zrównoważony rozwój, gmina Kęsowo, wsparcie instalacji OZE

ABSTRAKT

Celem opracowania jest przedstawienie problematyki z zakresu wspierania wytwarzania i dystrybucji energii pochodzącej ze źródeł odnawialnych na obszarze gminy Kęsowo. Energia pochodząca z odnawialnych źródeł pozwala na zwiększenie efektywności i bezpieczeństwa energetycznego. Urząd Marszałkowski w Toruniu w 2018 roku w ramach Regionalnego Programu Operacyjnego województwa kujawsko-pomorskiego prowadził działania wspierające wytwarzanie i dystrybucję energii z odnawialnych źródeł. Jednym z beneficjentów, który pozyskał informację z zakresu zapotrzebowania na OZE od mieszkańców województwa była gmina wiejska Kęsowo. W badaniach wykorzystano metodę desk research o charakterze analizy. Analiza literatury przedmiotu oraz dane z Urzędu Gminy Kęsowo pozwoliły na ustalenie faktów, weryfikację danych i prezentację wyników. Z możliwości wsparcia dla inwestycji w OZE, obejmującej instalacje fotowoltaiczne, instalacje kolektorów słonecznych oraz powietrznych pomp ciepła skorzystało 41 mieszkańców gminy Kęsowo. Badania wykazały, że gmina w pełni nie wykorzystwała dostępnej puli środków, a największym zainteresowaniem cieszyły się instalacje fotowoltaiczne, których średnia wnioskowana moc wynosiła 5,22 kW.

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