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The Role of Local Government in Implementing Renewable Energy Sources in Households (Podkarpacie Case Study)

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Abstract: The implementation of renewable energy in households can contribute to achieving climate goals, improving air quality and improving energy security. At the local level, this goal may be supported by local authorities, but in Poland, as in many countries, the use of renewable energy is not a mandatory task of local government units. The aim of this study is to analyze the role of local government, i.e., municipalities, in the adaptation of RES installations in residents' households. The source of empirical materials was a survey of households using renewable energy installations, carried out in 2021 in the Podkarpacie region in Southeastern Poland. It has been shown that the inhabitants benefit from the support of municipalities in financing the installations, as well as information and consulting support. Municipalities support renewable energy in the "civic" segment mainly through the implementation of the so-called umbrella projects. They have a positive effect on the adaptation of RES not only in the households of the project participants, but through the imitation effect, also in other households in the immediate vicinity. The municipality effectiveness in this type of activities depends on the efficiency of project implementation and the quality of information on the conditions of participation in the project and the benefits of renewable energy.

Keywords: renewable energy; local authorities; local governments; RES micro-installations in household; 'umbrella' programs

Citation: Kata, R.; Cyran, K.; Dybka, S.; Lechwar, M.; Pitera, R. The Role of Local Government in Implementing Renewable Energy Sources in Households (Podkarpacie Case Study). *Energies* **2022**, *15*, 3163. https://doi.org/10.3390/en15093163

Academic Editors: Sergio Ulgiati, Marco Casazza and Pedro L. Lomas

Received: 4 April 2022
Accepted: 25 April 2022
Published: 26 April 2022

1. Introduction

It is necessary to improve renewable energy development and energy efficiency in Poland. The European Union objectives around the climate and energy framework for 2030 [1] are related to the acceptance of the energy commitments by Poland and, together with social expectations, have become the main determinants of investments in this area. The National Energy and Climate Plan for 2021–2030 includes these obligations imposed on Poland, as in the case of other EU countries. The goal is to reduce the share of coal in electricity production to 56–60% and increase the share of RES in gross final energy consumption by 21–23% [2].

Poland's energy transition and the achievement of the climate and energy targets for 2030 and beyond will not succeed without the widespread development of energy based on renewable energy sources (RES) at the local level, including in rural areas [3].

In Poland, the basic territorial self-government units, i.e., municipalities, may constitute an entrepreneurial entity provided that they conduct a communal economy in the public utility sphere. The municipalities' own tasks in the field of water supply and the disposal and treatment of municipal wastewater are carried out from the budget of the local self-government [4]. Municipalities can also be active in the field of renewable energy production. This production can be used for the commune's own needs, e.g., for heating public buildings or street lighting, but it can also be delivered to other recipients

via the municipal or external energy network (electricity, heating). However, this does not exhaust the entire scope of the commune's activities in the field of renewable energy development. Communes can conduct information and promotion activities in their area, supporting the use of renewable energy [5]. Finally, they can support households and economic entities in implementing RES by engaging in joint investments, e.g., as part of the so-called umbrella projects.

The involvement of local governments aimed at increasing the use of RES by residents is not only important for achieving energy transition goals at the local level, but it can also help to reduce the "energy exclusion" of some households. It also fosters a more equitable energy transition by supporting the poorest households. Finally, it reduces harmful gas emissions and smog, and therefore promotes public health.

The problem in the realization of these goals is the limited budget resources available to local governments and the wide range of their public tasks. Among them, tasks related to RES implementation, especially among residents, may not be prioritized by local authorities. This is due in part to the fact that many of them are considered optional tasks. In view of the above, it is interesting to determine how municipalities are involved in supporting RES adaptation in households. The point, however, is to evaluate this involvement from the perspective of local residents—users of RES micro-installations. This issue is rarely addressed in research.

2. Literature Review

Many studies indicate that local governments can play a key role in implementing renewable energy at the local level [6,7]. Local authorities can initiate, invest, produce and be the end users of renewable energy [4,8]. Research on this topic is being conducted in various countries and regions. They most often refer to the following themes:

(1) The role of local governments in achieving energy transition goals at the local level, including increasing the share of RES in total energy consumption [6,9]. Many papers have argued that local governments can support local energy, low-carbon economy or energy efficiency improvements in the economy through local regulations, local taxes and fees, and through investments in the local energy sector. Municipalities can contribute to the achievement of local energy goals through participation in programs supporting the thermal efficiency improvement of buildings, replacement of heat sources or addition of RES installations in the households of their inhabitants. However, achieving these goals requires planned and often long-term actions [6]. Local governments can support the implementation of RES in households (i) through an example of its own investments in the area; (ii) as a promoter of local campaigns to inform citizens about the benefits of RES; and (iii) as a developer or beneficiary of projects for RES investments in the "civic" segment. Empirical evidence suggests that local governments' green energy initiatives have significantly contributed to the diversification of energy resources and have influenced energy policy in countries such as Denmark, Germany and the United Kingdom [9]. Many authors emphasize the significant role of local governments in the creation of community renewable energy (CRE), which are network or cluster initiatives that bring together various local actors involved in the generation, distribution and consumption of energy based on local distributed renewable sources [9–12]. In addition to local governments, the main stakeholders of CRE are local businesses and residents [10].

(2) Another theme referred to in the literature is the rationale for investment activity of local governments in the sphere of renewable energy [13,14] and the sources of their financing [5]. It is emphasized that the main barrier for the involvement of local governments is the high cost of investment in RES, which is often beyond their budgetary capacity [15]. In many countries, including Poland, the problem is the low scale of public support for this type of investment [16,17]. Moreover, investments in eco-energy are still ranked low by local governments in the hierarchy of preferences for local investments [13,18]. This hierarchy is largely due to the constraints of local budgets, which do not allow

local governments to expand their investments beyond mandatory tasks. This is especially true for those municipalities that are struggling with underdeveloped road infrastructure, underdeveloped water supply and sewage systems and poorly developed or worn out social infrastructure (schools, sports facilities, etc.). Investment in these areas is then prioritized and pushes RES projects behind. To some extent, budgetary constraints in the implementation of investments in renewable energy are reduced by the possibility of obtaining non-refundable sources of financing. Studies in many countries have proven that public subsidies have a large impact on municipal investment in renewable energy [5,14]. The results of a study by Klepacki et al. [14] conducted in Poland proved that access to grants from EU funds was the most important determinant of municipalities' investment in renewable energy. This factor was more significant than the financial health of those administrative units, hence the conclusion that local governments, largely regardless of their financial condition, are not willing or able to finance RES investments from their own resources. However, they are willing to undertake such projects when they are supported by non-refundable (grants) or at least partially non-refundable (loans with partial debt forgiveness) funds. An important financial factor limiting the involvement of local governments in RES-related investments is their debt [19]. Studies conducted in Poland have shown that with high levels of debt, municipalities are not interested in investing in RES [18]. The effectiveness of local governments in activities for sustainable energy and climate requires a well-planned and long-term energy policy. In this respect, the cooperation of local authorities with various local stakeholders is necessary: companies, residents, NGOs, research institutions, media, etc. It also requires taking into account the needs of these stakeholders in the strategy of actions for the wider implementation of renewable energy and energy transformation. The concept of the Sustainable Energy and Climate Action Plan (SECAP), initiated by the organization called the Covenant of Mayors, may be helpful in this regard. It is a concept of activities for the energy and climate transformation, which involves a detailed analysis of the energy situation and greenhouse gas emissions in a commune (in the city). It sets out actions to reduce emissions, increase energy efficiency and adopt renewable energy targets, while taking into account the issue of energy poverty. In Europe, more than 10,000 local and regional authorities from 54 countries have joined the initiative. During the design and implementation phase, SECAP helps to raise public awareness of the climate crisis and energy efficiency. It provides an opportunity for active communication between residents and local governments while contributing to the achievement of greenhouse gas reduction goals by reducing energy consumption and increasing the production and use of renewable energy [20].

(3) A factor to be considered in order to understand the active role that local administrations can play in RES development is the relationship between the decisions and actions of local authorities in the energy sphere and the expectations of residents. In actual fact, despite the population's generally favorable attitude to RES, public opposition to the installation of RES facilities is becoming an obstacle [21]. It has been shown that targeted information campaigns driven at a municipal level, such as pilot projects developed by LAs, alone or in partnerships, can be a precious tool to help overcome such non-technical barriers [19]. Between 2016 and 2021, Poland witnessed more cooperation between local authorities and residents in this field through the implementation of so-called umbrella projects [13,18]. These are projects implemented by municipalities, which consist in organizing and co-financing the installation of RES micro-installations in residents' households (PV panels, solar panels or heat pumps). They were financed with EU funds, from the Financial Perspective 2014–2020, under 16 Regional Operational Programmes (ROPs). Similar projects will also be implemented under the EU Financial Perspective 2021–2027. Umbrella projects not only contribute to the increase of renewable energy generated by the ultimate beneficiaries, i.e., users of the installed systems, but through imitation (imitation effect), they also contribute to greater acceptance and implementation of this technology by more households [3]. Many studies conducted in

different countries confirm the occurrence of the imitation effect being part of the "local cognition and learning process" for PV and solar technologies [22,23]. Local acceptance is recognized as one of the main determinants of renewable energy use at the local level [13,24–27]. Social conflict around RES installations often hinders the implementation of such investments, especially of medium to large scale. In Poland, such social risks have emerged in many municipalities between 2016 and 2021 for onshore wind farms, due to legislation that prohibits residential development at a distance equal to 10 times the height of the wind turbine (including the blade) [28–30]. The damage to public attitudes towards wind energy caused by such "flawed" regulations may continue to hinder wind farm investments, even after the liberalization of the "distance"-based law provisions, as announced by the central government [31]. In this context, the role of local authorities as actors who can mitigate or prevent potential conflicts around RES investments through appropriate local energy policies and long-term energy planning and responsible RES investments becomes particularly important. Research by Zoellner et al. [32] conducted in Germany shows the need to involve residents in the process of energy planning and decision making, especially with regard to large investments. Many authors emphasize the role of local governments in promoting changes in residents' awareness and attitudes regarding climate change and energy consumption, as well as their ability to motivate residents to engage effectively by acting as role models and leading by example on energy issues [13]. The embeddedness of renewable energy sources in public consciousness is still weak and uncertain [33]. The lack of public awareness is a major barrier to the acceptance of renewable energy technologies. Social networks are an important source of shaping public opinion and knowledge in the field of renewable energy [34]. Research conducted in Hungary confirms that the implementation of renewable energy at the local level (use of biomass for energy purposes) requires local authorities not only to provide financial support for such investments, but also to support information and shaping pro-ecological attitudes among local residents [35]. The dissemination of information and knowledge about RES requires a multilevel of activities and various instruments. It is all about making society aware of the need to save energy and replace conventional energy with "green" energy. In these activities, the role of local authorities as opinion leaders is very important [33].

(4) Another important theme addressed in the literature is the active role of local governments in addressing energy poverty. Energy poverty occurs when a household is unable to afford sufficient heating, cooling, lighting and energy to run appliances as a result of a combination of low income, high energy expenditure and poor energy efficiency of the domestic building [36–38]. Energy poverty is a problem that affects all countries in Europe and the world to varying degrees. Many experts believe that the use of renewable energy is a solution that can reduce the problem of energy poverty, despite the challenges and limitations associated with the use of this energy source [39–41]. The higher cost of renewable energy compared to conventional sources remains a significant problem, which, combined with the usually low income of those in energy poverty, greatly limits the possibility of reducing it through RES adaptation. Investments in RES should be viewed from a long-term and holistic perspective, taking into account social, environmental and climate-related benefits, and not only the economic calculation. This perspective allows us to see the advantage of green energy over conventional energy also in the context of energy poverty reduction [42]. Adaptation of RES technologies in economically and energetically poor households is not possible without public support.

This article does not deal directly with any of the above-mentioned problem threads, although it refers to them. The research focuses on the role of the local government in implementing RES in households through various instruments, i.e., financial (subsidies), information, marketing, consulting and organizational instruments. An attempt was made to define the gap between what local governments do for the adaptation of RES by households and what residents expect. In this aspect, the research offers a diagnosis of a specific reality and has an application character. We are looking for opportunities to

improve the activities of local government in the direction of a better adjustment to the expectations of residents.

3. Rationale for the Involvement of Polish Municipalities in Supporting RES Installations in Households

In Poland, strategic documents such as the National Energy Policy [43] and the Energy Law Act of 10 April 1997 (Journal of Laws 2019 item 755 as amended) indicate that the objective of the state is to ensure the energy security of the country, increase the competitiveness of the economy and its energy efficiency, as well as protect the environment. Local government units are required to support the central government in achieving energy policy objectives at the local level by:

- maximizing the use of locally existing renewable energy potential;
- supporting infrastructure investments of strategic importance for national energy security in the area of municipalities.

Pursuant to Article 7(1) of the Act of 8 March 1990 on municipal governments (Journal of Laws of 2019 item 506 as amended) "To meet the collective needs of the community is one of the municipalities' own tasks", the "supply of electricity and heat and gas" is also listed among the tasks of the municipality. Moreover, Article 18 of the Energy Law states that the municipality's own tasks include planning and organizing the supply of heat, electricity and gas fuels in the municipality, planning and financing the lighting system in the municipality, as well as planning and organizing activities to rationalize energy consumption and promoting solutions to reduce energy consumption in the municipality.

It should be emphasized that the Polish law does not give local governments many tools to effectively stimulate the development of RES. Some of the activities are realized by municipalities as tasks from the public utility sphere (e.g., energy generation from RES for street lighting or heating of public buildings). Other activities can be classified as own tasks in a broader sense, and still others as optional tasks (e.g., participation in "umbrella" programs) [44].

Therefore, local governments in Poland may or may not support renewable energy. However, research shows that local governments try not only to perform mandatory tasks in the sphere of local energy, but also willingly engage in optional activities. The main factor determining their involvement in this area is access to external funding [5,13,14].

Through umbrella projects, municipalities help households to implement specific technology related to renewable energy generation. Such projects are financed with EU funds under the Regional Operational Programmes. In Podkarpacie, under the previous EU Financial Perspective, municipalities applied for subsidies for umbrella projects for RES support in households from the Podkarpackie Voivodeship under ROP 2014–2020, Measure 3.1. RES development—umbrella projects. Between 2016 and 2021, such projects were implemented in the study region by almost all municipalities, either on their own initiative or as part of municipal associations or inter-municipal agreements. The municipalities (their unions or associations) were direct beneficiaries of the projects, but the actual (final) beneficiaries were households, i.e., users of the RES installation purchased and installed with the project funds on the property (plot of land, residential or other building) owned by the user. Individuals engaged in business or agricultural activities were also eligible to participate. The principle of the project is that the energy generated from the RES micro-installation should be used for the household's own needs, and only the unused part can be fed into the external grid.

Under such an umbrella project, a municipality prepares, commissions and coordinates the construction of RES micro-installations (e.g., PV installations, solar collectors, heat pumps) used by households in the municipality. The project can be financed with public funds (EU funds) for 85% of the eligible expenses, so the end user pays only 15% of the expenses as their own contribution. However, usually, the user's

own contribution is higher (reaching up to 40%), because the competitions for umbrella projects award extra points for a higher own contribution of the users [45]. The installation is covered by a 5-year warranty, and, after this time, it becomes the user's property.

The involvement of local governments in such projects is particularly necessary in the area of combating energy poverty, which, in Poland, according to CSO estimates based on the Low Income High Costs (LIHC) method, affected 17.1% of households in 2013, while in 2016, the corresponding rate was 14.1% [36,46]. Another study, based on the multidimensional energy poverty index, indicates that in 2020, energy poverty affected approximately 10% of households [47]. In general, studies indicate that energy poverty in Poland decreased between 2012 and 2020, largely as a result of increased household income [48]. However, it is still a significant problem both in terms of the scale of the phenomenon and its concentration in certain groups of households.

There are certain groups in society that are at greater risk of energy poverty than others. In Poland, such groups primarily include: (1) households headed by retirees and (2) indigent households with children in rural areas [37].

Solid fuels, such as coal or wood, are still used in Poland to heat houses and domestic water, and this is a symptom of energy poverty [49]. Furthermore, especially in the context of coal consumption, it results in CO_2 emissions and the emission of harmful gases and dust to humans. In Poland, approximately 44,000 people die every year as a result of smog generated by domestic stoves [50]. Therefore, improving air quality becomes a priority of public health policy.

The condition for the development of RES in the local sphere is the creation of a favorable system of financing these investments [13,18]. With the income of many households in Poland still relatively low, especially in rural areas, it is impossible to intensify activities related to the increase of green energy production without economic incentives.

Households in Poland may use external sources of financing for RES micro-installations. Funds for this purpose are offered by the banking sector, in the form of loans or leasing. These products in some banks (e.g., BOŚ Bank, PNB Paribas, Credit Agricole) are dedicated to RES and have slightly lower interest rates than "ordinary" loans, lower or zero commission or more favorable repayment conditions (e.g., longer grace period). Some banks also act as intermediaries in the distribution of loans to finance RES, which are financed with public funds. Support programs for energy transformation, including RES micro-installations in the form of grants or loans from domestic and foreign funds (mainly from EU funds), have been available for households for several years.

Support from EU funds can be sought by households through municipalities by participating in umbrella programs, while support for distributed renewable energy sources from national public funds is provided by the National Fund for Environmental Protection and Water Management—NFEP&WM—often through 16 provincial funds (PFEP&WM). It takes the form of various programs dedicated to households, farms, but also cooperatives and housing communities. These programs include "My Electricity", "Clean Air", "Energy Plus", "Prosumer", "Agroenergy" or "Stop Smog", among others [18]. The support instruments are a grant, a loan or a loan combined with a subsidy for a part of the installation costs. In most of these programs, households directly apply for support at the program management institution, such as PFEP&WM. It is also quite common for the beneficiaries to use the assistance of the companies delivering the RES installation and performing its installation service. In the case of the "Stop Smog" program, municipalities can obtain funds and co-finance the installation of RES in single-family residential buildings. Support should go to households at risk of energy poverty (using social welfare benefits) and located in municipalities with so-called anti-smog resolutions. Residents can receive a grant covering up to 100% of the cost of the project. However, the "Stop Smog" program, launched in 2019, did not attract much interest from municipalities, as it required a minimum 30% municipal contribution (by the end of Q1. 2021, only seven municipalities benefited from it).

4. Materials and Methods

The aim of this research is to determine the role of local government, i.e., municipalities, in the adaptation of RES installations in residents' households. In particular, the aim is to determine which activities of the municipality contribute to the growth of RES installations in households and how these activities are assessed by residents, i.e., users of such installations.

The study was conducted in the Podkarpacie region of Southeastern Poland. The choice of Podkarpacie is due to the fact that, next to the Lubelskie, Podlaskie and Opolskie Voivodeships, this region records the highest level of the energy poverty index (LIHC) [46]. This is, among other things, due to the relatively lower disposable income of households compared to other regions of the country [51]. Moreover, Podkarpacie is distinguished by a high percentage of households that use fossil fuels (coal and wood) for space heating [46,48,52].

The Podkarpackie Voivodeship has good natural conditions for the development of the infrastructure of renewable energy sources. The region has one of the best solar conditions in Poland and, in some areas of the region, also good conditions for the development of wind and water energy. It also has high potential for agricultural biomass, as, in the last two decades (2000–2020), there has been decreasing demand for straw in agriculture, which is the result of a decline in livestock production [53]. The region is characterized by a significant share of cereals in the structure of crops (75.8%, compared to 69% on average in the country) and a large share of permanent grasslands in the structure of agricultural land (37.6%, compared to 21.7% in the country), of which a significant aspect is that it is not used for agricultural production [54]. The region is also characterized by high forest cover. However, the potential of the voivodship in terms of the development of renewable energy is relatively poorly used. This applies not only to large RES installations, but also to distributed local energy and renewable energy micro-installations in the household segment. The share of renewable energy sources in the production of electricity in the voivodship amounted to approximately 15.9% in 2020, compared to the national average of 16.3% [53–55].

The role of municipalities in the development of local distributed renewable energy was considered from the perspective of those residents who have implemented RES technology in their household in the form of a PV system, solar installation or heat pump. Some of them have benefited from financial support for RES investments through the municipality by participating in an umbrella project.

The empirical analyses were based on a survey conducted at the end of 2021 on a sample of 195 purposively selected households living in single-family buildings and using an RES installation.

The minimum sample size was estimated using an appropriate formula for a finite population [56]:

$$N_{min} = \frac{P(1-P)}{\frac{e^2}{z^2} + \frac{P(1-P)}{N}}$$

where: P—estimated fraction size; z—value resulting from the adopted significance level (α), calculated using the cumulative distribution function of the normal distribution; N—size of the general population (in the case of a finite population); e—maximum estimation error.

With a significance level of 0.05 and based on reliable public statistics allowing one to estimate the minimum number of RES installations in the Podkarpackie Voivodship (estimated fraction of 5.73% of the general population estimated at 377.7 thousand) [57,58], the minimum number was 130. Due to the limited number of returns, the study population was increased to 260, ultimately resulting in 195 questionnaires that were returned. The structure of the analyzed sample was diversified in terms of gender, age, education and income (Table 1) and corresponded to the statistics characterizing Podkarpackie.

Table 1. Characteristics of the research sample (%).

Gender		Age [y]			Education				Income per 1 Person (PLN)			
Male	**Female**	**To 39**	**40–59**	**60 and More**	**Primary**	**Vocational**	**Secondary**	**Higher**	**To 1000**	**1001–2000**	**2001–3000**	**Over-3000**
50.8	49.2	36.4	37.4	26.2	14.9	30.8	37.4	16.9	21.0	22.6	32.3	24.1

The ECB exchange rate is 1 PLN = 0.214 EUR (https://www.ecb.europa.eu, accessed on 13 April 2022). Source: own survey.

The survey was conducted with adults who were the decision makers in the households. The survey questionnaire included, among others, questions about factors determining the decision to implement investments in RES, as well as support for investments by external institutions, including the local government.

The logistic regression method was used to establish the factors that determined whether a household benefited from the municipality's assistance in making an investment in RES through participation in an umbrella project. The chi-square independence test (χ^2) and the C-Pearson contingency coefficient were used to establish associations between the characteristics of households and their decision makers and the evaluation of the credibility of institutions promoting RES and the evaluation of municipalities' actions in supporting RES under umbrella projects. The following hypotheses were analyzed:

H1. *The quality of information about the conditions of participation in the umbrella project and the benefits of RES installation, as well as the efficiency of project implementation, influence the likelihood of a household to benefit from the municipality's support;*

H2. *The municipality's actions in terms of financial support for RES investments in the "civic" segment are best evaluated by elderly residents and those with relatively lower incomes;*

H3. *The assessment of the credibility of the local administration as an incentive to invest in RES is independent of the age, education and income status of household decision makers.*

In the logistic regression model, the dependent variable is dichotomous, i.e., it assumes the value 1 when the desired event occurs or the value 0 when such an event does not occur. For a given case i, the probability of the variable y taking the value 1 or 0 is:

$$P\ (y_i = 1) = p_i,\ P\ (y_i = 0) = 1 - p_i$$

The probability is a function of the vector of explanatory variables x_i and the parameter vector β, and therefore:

$$p_i = P\ (y_i = 1) = F(x_i^T \beta\ ) \text{ for } \quad i = 1, 2, \ldots, n$$

The logit model assumes that the probability p_i corresponds to the distribution of the logistic distribution [59]:

$$p_i = \quad F(x_i^T) = \frac{1}{1+\exp\ (-x_i^T \beta)} = \frac{\exp\ (x_i^T \beta)}{1+\exp\ (x_i^T \beta)}$$

The parameters (coefficients) of the logistic regression model are estimated using the maximum likelihood method [60]. Parameters $\beta_0, \beta_1, \ldots, \beta_k$ for known values $y_1, x_{1i}, \ldots, x_{ki}$ must be estimated in such a way that they provide the maximum value of the logarithm of the reliability function.

The logistic regression model can be defined in more detail:

$$P\ (Y = |x_1, \ldots, x_k) = \frac{exp^{\beta_0 + \beta_1 x_1 + \cdots + \beta_k x_k}}{1+exp^{\beta_0 + \beta_1 x_1 \ldots + \beta_k x_k}}$$

where $\beta_1, \ldots, \beta_k$—logistic regression coefficients.

In the analysis under consideration, the fact that a household participates in an umbrella project implemented by the municipality, and thus the fact of direct assistance of the municipality in the financing and installation of an RES installation (PV, solar, heat pump) was taken as the explanatory variable (Y_1). The variable Y_1 was defined as follows:

Y_{1i} = 1—If the *i*th household has implemented the RES installation thanks to the support of the municipality (under the umbrella project);

Y_{1i} = 0—If the *i*th household does not have such an installation

where i = 1, 2, …, n—the number of surveyed households.

The variable Y_1 was determined for all units included in the study. The input set of independent variables for the logit model estimation were the variables marked with symbols from X_1 to X_{12} (Table 2).

Table 2. Explanatory variables used for the estimation of the logistic regression model.

Variable	Symbol
Methods of informing and encouraging investment (points −2 ÷ 2)	X_1
Quality of consulting (points −2 ÷ 2)	X_2
Amount of the subsidy (PLN)	X_3
Degree of complexity of the documentation (points −2 ÷ 2)	X_4
Speed of investment implementation (the time from the notification of the willingness to purchase the installation to the completion of the investment) (points −2 ÷ 2)	X_5
Impact on the reduction of bills (points 1 ÷ 5)	X_6
Flexibility and individual approach to the client (points −2 ÷ 2)	X_7
Quality of the offered and installed devices (points −2 ÷ 2)	X_8
Flow of information about progress of investment (points −2 ÷ 2)	X_9
Possibility of choosing the installation to customer expectations (points −2 ÷ 2)	X_{10}
Quality of the installation service (selection of professional assembly teams) (points −2 ÷ 2)	X_{11}
Quality of technical supervision (inspection and acceptance of the installation) (points −2 ÷ 2)	X_{12}

Source: own survey.

The chi-squared test of independence (χ^2) was used to verify the hypothesis of the independence of the two variables Xi and Yi measured on nominal scales [59]. This hypothesis can be written according to the concept of independence of random variables as follows: H0; features X and Y are independent and H1; features X and Y are dependent, with the adopted significance level of α = 0.05. To verify the hypotheses, a (χ^2) statistic, expressed as the following formula, was used:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{k} \frac{\left(n_{ij} - \hat{n}_{ij}\right)^2}{\hat{n}_{ij}}$$

In order to determine the strength of the relationship between the studied features, the C-Persona contingency coefficient was used, which was calculated as shown below [60]:

$$C = \sqrt{\frac{\chi^2}{\chi^2 + n}}$$

where:

C—C-Persona contingency coefficient;
χ^2—chi-squared;
n—number of observations.

The C-Pearson coefficient assumes values [0, 1], where C = 0 means the independence of features and C = 1 indicates a strong relationship.

5. Results of Empirical Studies

5.1. Subsidies as a Source of Financing RES Installations in Households in Podkarpacie

Of the 195 surveyed households with a renewable energy system, 75.4% were equipped with a PV system, while 47.7% were equipped with solar collectors. Other RES installations were owned by a total of 12.4% of respondents, with heat pumps in 4.6%, biomass boilers in 4.6% and small wind turbines in 3.2%. Almost two thirds of the households used only one RES installation, 32.3% had two installations (PV panels and solar collectors, less frequently heat pumps), while 3.1% had three RES installations. Most often, these installations were set up between 2019 and 2021 (87.4%), which illustrates that government and regional programs to support RES investments among residents, available on a broader scale from 2019 onwards, were quickly producing positive results. This is also evidenced by the data of the Energy Regulatory Office [50], which indicate that in Poland in 2019–2021, it was possible to observe a very dynamic growth in the segment of prosumer PV micro-installations. By 2020, electricity was generated in 458,600 PV microinstallations, and their total capacity was over 3000 MW. In comparison, at the end of 2019, there were 155,100 such installations; at the end of 2018, there were only 51,000, and the capacity of the micro-installations was 344 MW [61].

When analyzing the respondents' answers to the question about the sources of financing of the RES micro-installation, one should keep in mind that, usually, such investment is financed by the combination of the funds of the household and external funds.

In the case of the surveyed collective, 17.9% of households financed the RES investment entirely from their own funds. The remaining households (82.1%) benefited from various external funding sources, including 71.8% from non-repayable grants. Moreover, 39.5% of the surveyed households benefited from the RES investment subsidies offered by the municipality under umbrella programs (Figure 1). Slightly fewer (31.8%) benefited from grants from the National (or Voivodeship) Fund for Environmental Protection and Water Management (NFEP&WM or PFEP&WM), obtained from such programs as "My Electricity", "Clean Air" and "Prosumer". Bank loans to finance RES micro-installations were utilized by 32.3% of the respondents. Loans were most often used to cover the deductible when applying for grants. Often, residents used more than one source of funding, and for 98.4% of households, the financial sources also involved their own funds. In addition to direct sources of financing for RES installations, nearly two thirds of the respondents (64.1%) also took advantage of the "thermal efficiency improvement tax credit" from their income tax. This tax credit was introduced in 2019 [62]. It entitles the taxpayer to deduct from the tax base the expenses (up to PLN 53,000) incurred for the purchase and installation of PV, solar or heat pump systems.

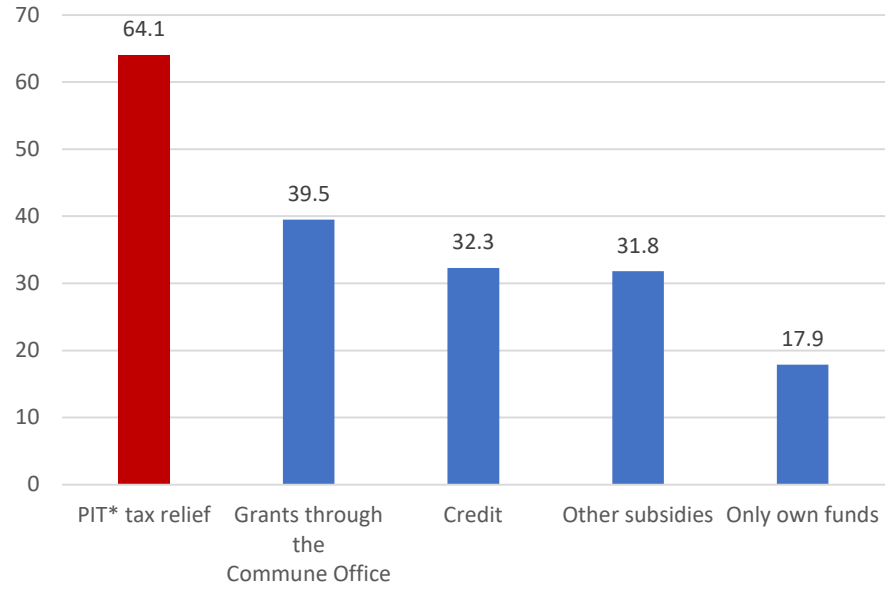

Figure 1. Percentage of households by source of financing RES installations (%). * PIT—Personal Income Tax. Source: own survey.

In total, 47.4% of the surveyed households benefited from the municipality's assistance in implementing RES technologies, with 39.5% receiving financial support through the umbrella project. Others received assistance in applying for government subsidies, mainly from the "Clean Air" program, through information, assistance in filling out the application and completing the necessary documents. Some municipalities have set up special information and consultation points for residents to help them to apply for grants from this program. The costs of establishment and operation of these points were partially covered from public funds (from NFEP&WM subsidies).

Respondents who did not use any subsidies to finance their RES investments indicated a lack of knowledge regarding the possibilities to obtain support and related procedures as the main reason (Figure 2). Other reasons included a lack of time to deal with all the formalities related to obtaining a grant or not meeting the formal and legal criteria for accessing a grant. Most often, it was a question of income criteria or ownership of the property on which RES installations were to be implemented.

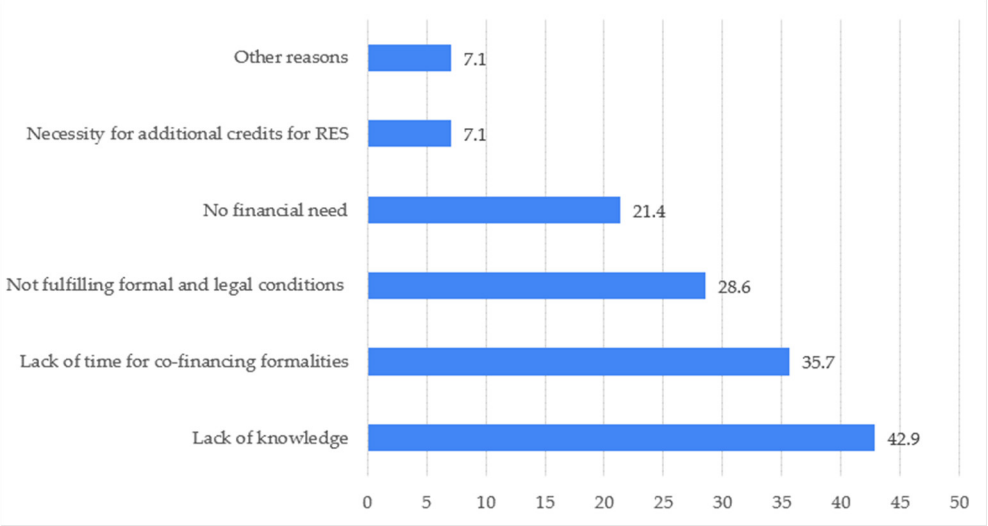

Figure 2. Reasons for resignation from RES investment subsidies in households (% of respondents). Source: own survey.

Some households did not join the umbrella projects because of the many uncertainties that these projects entailed. The issues at stake included the cost of installation, its profitability (period of return on investment), fire safety regulations, insurance and possible technical guarantees, etc. These reasons were particularly evident in the case of the first projects implemented by municipalities in the region. By exchanging experiences, local governments gained knowledge over time on how to deal with specific problems. In turn, the inhabitants, seeing the positive effects of joining the projects by their neighbors, were also more willing to join subsequent calls for proposals or new projects. The well-known, and noted in the literature, imitation effect [22,23] worked here.

To identify the determinants of applying for grants through the municipality (i.e., participation in the umbrella project), a logistic regression analysis was conducted (Table 3). The dependent variable Y_1 is a binary characteristic (0/1), where 1 indicates the fact of participation in the umbrella project and 0 indicates no such participation. The significance of the statistical parameters of the model was verified based on Student's *t*-test, and the adopted level of significance was $\alpha = 0.05$.

Table 3. Parameters of the logit regression model for the Y_1 variable determining the probability of using the subsidy from the Municipal Office for the purchase of RES installations.

Variable	Factor	Standard Error	Statistics t	*p*-Value
Const	1.6252	1.9274	0.8431	0.4002
The methods of informing and encouraging investment	0.5440	0.2902	2.0152	0.0237
X_4—The degree of complexity of the documentation	−0.7352	0.2493	−2.0390	0.0209
X_5—Speed of investment implementation (the time from the notification of purchase the installation to the completion of the investment)	−0.5376	0.2625	−2.0050	0.0306
X_6—Impact on the reduction of bills	0.5537	0.2371	2.3352	0.0206
X_9—Flow of information about progress of investment	0.9296	0.3699	2.5129	0.0128
Number of observations = 195; *p*-value = 0.05; Number of cases of correct prediction 90.3%; Chi-square = 92.7%; Corrected $R^2 = 0.41$; McFadden $R^2 = 0.56$.				

Source: own survey.

The model parameters for several of the independent variables are statistically significant, so the factors listed had a significant impact on the probability of benefiting from the RES subsidy through the municipality. This likelihood increased when residents rated highly the quality of information about the umbrella project and information about the benefits of investing in RES (X_1). A household's decision to participate in the umbrella project was also effectively influenced by the positive assessment of the installation's impact on energy bills (X_6). A negative effect on variable Y_1 was shown for variable X_4, the complexity of documentation associated with participation in an umbrella project. Similarly, the delay period between the household joining the project (signing the agreement with the municipality) and the finalization of the investment (X_5) decreased the likelihood of benefiting from the municipality's support (Table 3).

Variable X_9, i.e., evaluation of the flow of information (between the municipality and the project beneficiaries) about the progress of the investment, was shown as a stimulant of participation in an umbrella project (Table 3). Umbrella projects tend to be heavily stretched over time. The reason for this state of affairs is the procedures related to obtaining EU funds and project implementation. Each project is connected, among others, with conducting tender procedures aimed at selecting the supplier and contractor of the RES installation. In this situation, reliable and accessible information from the municipality about the progress of the project and the conditions of its implementation (technical parameters of the installation, installation dates, etc.) is highly appreciated by the project participants.

The percentage of respondents' indications proves that knowledge and information obtained from neighbors and acquaintances who already had a RES micro-installation had the greatest influence on the decision to invest in RES. Their example was important, which confirms the power of the imitation effect.

Another significant source of information about RES is the Internet and, more broadly, social media—in particular, the knowledge gained by respondents on numerous portals and expert blogs devoted to eco-energy. Such information was used by four out of five respondents; however, the knowledge obtained in this way was a decisive factor for making an investment in RES for a total of 31.8% of respondents. Among the actors that had a key influence on the decision on this issue, respondents indicated RES equipment suppliers and installers (16.9%), followed by local government employees (11.4%) and other individuals and entities (Figure 3).

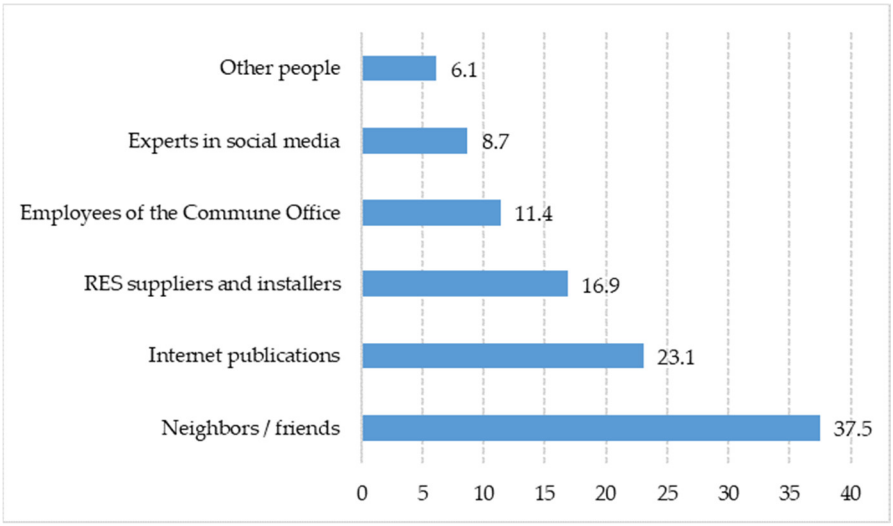

Figure 3. Entities with the greatest impact on the households' decision of RES investment (% of households). Source: own survey.

The results of the survey confirm the high activity of the companies dealing with the supply and installation of RES systems in encouraging such investment (Figure 4). For these companies, the strong demand in the "civic" photovoltaic segment starting in 2019 presents an opportunity for high profits. Hence, 9 out of 10 respondents had direct contact with companies offering to supply and install the systems. Many respondents also encountered encouragement to implement RES technologies online, in social media, in the press or television (Figure 4). Against this background, the activity of local administration is relatively low, as only 4.6% of respondents encountered actions encouraging them to install RES over the past six months. This result is not surprising if one takes into account that the promotion of RES among inhabitants is an optional task of the municipality. However, one can ask whether leaving the active promotion of RES only in the hands of commercial companies and more or less independent experts from the industry is an optimal solution. It seems that if the municipalities want to implement a long-term strategy of RES development, they should engage more extensively in this type of activities. It is not about dispersed actions directed to individual inhabitants. The effectiveness of municipalities in this area requires diverse, long-term actions, directed at raising the environmental awareness and knowledge of residents about RES. The municipalities can prepare publications and websites dedicated to RES, informing about technical issues, the benefits of green energy and the offer of RES financial support from their own and other institutions. They can inform residents about the good practices of other municipalities in implementing RES technologies and the benefits of doing so.

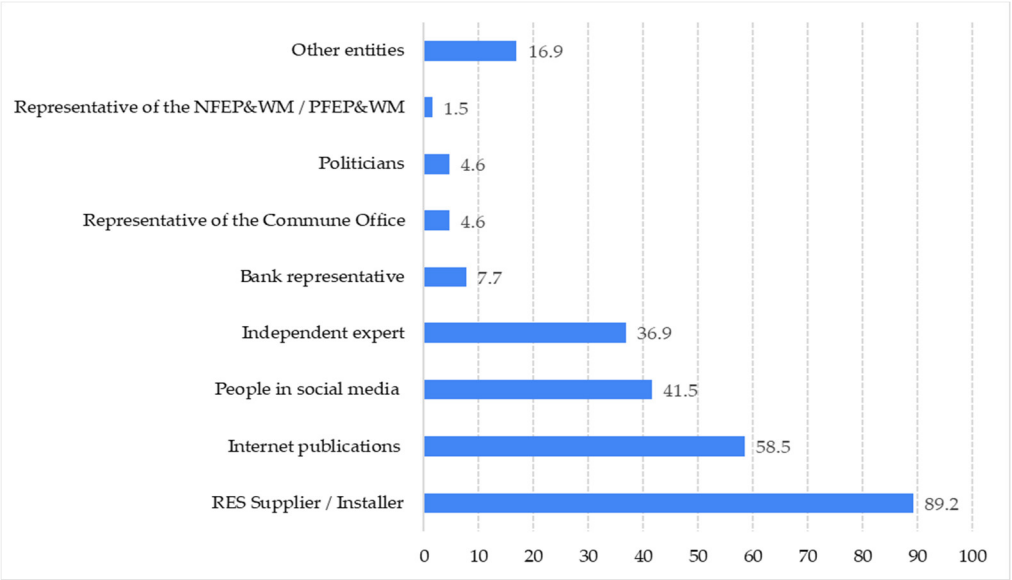

Figure 4. Entities encouraging households to implement RES installations in the last 6 months (% of respondents). Source: own survey.

A particularly important issue is to support energy-poor households in replacing heat sources, which is also vital for reducing the emission of harmful gases and dust. In many regions of Poland, including Podkarpacie, anti-smog resolutions have been adopted (Resolution of the Sejmik of Podkarpackie Voivodeship No LII/869/18 of 23 April 2018) [63]. The resolution imposed a gradual obligation to replace old off-class coal and wood boilers from 1 January 2022 on. For many poor households, compliance will be very difficult or impossible without public support. Such support is offered in the framework of the government program "Clean Air", but the scale of support offered from this source is not able to cover all needs. Municipalities can be involved in solving this problem through information and consulting activities, i.e., assisting residents in obtaining grants. Such activities are already implemented (consultation points in the municipal offices), but still very few local governments take part in them. It is also possible to create local support programs for heat source replacement through subsidies for households from the municipal budget. The problem in this aspect is budget constraints.

Respondents who benefited from the municipality's assistance in RES adaptation through participation in an umbrella program were asked to evaluate selected elements of the support received. The results, reported on a rating scale of −2 points to 2 points, are shown in Table 4.

Respondents positively rated only four of the twelve elements of support presented. The highest marks, at a good level, were given to the quality of technical supervision (inspection and acceptance of installations), followed by the flow of information about the progress of investment, the quality of installation services (selection of professional installation teams) and investment realization time. All other elements of support were rated negatively (Table 4).

Table 4. Assessment of selected elements of support by municipality for RES installations in households—opinions of the respondents *.

	Total	Age [y]			Income [PLN **]			
		To 39	40–59	60 and More	To 1000	1001–2000	2001–3000	Over 3000
The methods of informing and encouraging investment	−0.09	0.03	−0.36	0.67	0.00	0.00	0.06	−0.23
The quality of consulting	−0.02	−0.03	−0.04	0.33	0.33	−0.15	0.11	−0.07
The amount of the subsidy	−0.14	−0.03	−0.25	−0.67	0.67	0.31	−0.17	−0.41
The degree of complexity of the documentation	−0.34	−0.33	−0.44	0.33	−1.00	−0.23	0.00	−0.53
Speed of investment implementation	0.04	−0.03	0.04	0.00	−0.33	−0.69	0.33	0.13
Impact on the reduction of bills	−0.28	−0.06	−0.58	−0.33	0.33	0.43	−0.71	−0.43
Flexibility and individual approach to the client	−0.08	0.00	−0.24	0.33	−0.33	−0.15	−0.06	−0.03
The quality of the offered & installed devices	−0.09	−0.06	−0.16	0.00	0.33	0.00	0.00	−0.23
Flow of information about progress of investment	0.37	0.36	0.36	0.67	0.33	0.00	0.56	0.43
Possibility of choosing the installation to customer expectations	−0.25	−0.14	−0.44	0.00	1.00	−0.31	−0.39	−0.27
The quality of the installation service (selection of assembly teams)	0.22	0.33	−0.04	1.00	0.67	0.38	0.22	0.10
Quality of technical supervision	0.68	0.33	−0.04	1.00	0.67	0.38	0.22	0.10

* Rating scale: from −2 to 2, where −2—very bad, −1—bad, 0—neither good nor bad, 1—good, 2—very good. ** The ECB exchange rate is 1 PLN = 0.214 EUR (https://www.ecb.europa.eu, accessed on 13 April 2022). Source: own survey.

5.2. Assessment of Support from the Municipalities by Beneficiaries of Umbrella Projects

These responses do not invalidate the overall positive evaluation of the umbrella project implemented by the municipality. If this were not the case, respondents would not have participated. This does not mean, however, that they abstain from criticism of its various elements. These negative evaluations should be read as suggestions for improving specific elements of the projects. The most negative evaluations concerned the complexity of the documentation needed to obtain support and the lack of (limited) possibilities to adjust the technical parameters of the installation to the needs of a given user. This was due to the specific nature of the projects in which, as a result of the tendering procedure, a narrow range of installations was offered. Respondents were also critical of the installation's impact on reducing energy costs. However, this assessment may have been due to the fact that most of the installations were in operation for a very short time (several months). The benefits of the installation should be considered in the long term and a full return on investment should be expected only after several years.

The evaluation of the different elements of the umbrella project differed significantly with respect to the age groups of the respondents (Table 4). Respondents in the 40–59 age range were the most critical group. In their case, almost all aspects, except for the flow of information about the project and the time of investment implementation, were evaluated negatively (Table 4). In the case of respondents under the age of 40, the average ratings were better, and four elements of the municipalities' service package received positive ratings (Table 4). The ratings for people aged 60 and above were radically different; apart from a negative assessment of the subsidy amount (−0.67 points) and the impact of the installation on the reduction of energy bills (−0.33 points), other elements of the support were rated positively.

Respondents whose households earned the lowest income per capita (up to PLN 1000/month) assessed the municipality's offer of RES support much more positively than respondents representing households with higher income (Table 4). For this group of households, only the complexity of the documentation, the speed of the investment

realization and the flexibility of the offer were evaluated negatively (Table 4). In the next two income groups, ratings for most elements of the municipalities' package were positive, but the average rating was lower than in the first income group. In addition, more items received a negative or neutral rating (0 points). Representatives of households with the highest income per family member (more than PLN 3000/month) were definitely the most critical of the municipalities' package. In this group, as many as eight elements of support received a negative evaluation (Table 4). It seems that this high number of negative ratings is due to the relatively higher expectations of higher-income respondents, who are accustomed to a higher standard of living.

Among the entities that are trusted by the respondents in the area of RES promotion, the representatives of the local administration occupy a high position. Positive ratings of their reliability are found in all age groups of respondents (Table 5). On the other hand, the only group with negative opinions, across the income groups, was the group of households with income between PLN 1.001 and 2.000.

Table 5. Credibility of entities encouraging RES investment in the opinion of the respondents *.

		Age [y]			Income [PLN **]			
	Total	**To 39**	**40–59**	**60 and More**	**To 1000**	**1001–2000**	**2001–3000**	**Over 3000**
Independent expert	0.56	0.43	0.71	1.00	0.67	−0.36	0.72	0.80
Representative of the Commune Office	0.47	0.49	0.46	0.33	0.67	−0.09	0.28	0.77
Internet publications	0.44	0.49	0.32	1.00	0.33	0.17	0.22	0.70
People in social media	0.43	0.34	0.52	0.67	−0.67	−0.58	0.44	0.93
Representative of the NFEP&WM/PFEP&WM	0.39	0.54	0.21	0.00	0.67	0.09	0.22	0.57
Other entities	0.38	0.41	0.39	0.00	0.00	−0.14	0.60	0.43
Bank representative	0.08	−0.03	0.19	0.33	1.00	0.00	0.11	0.00
RES Supplier/Installer	−0.27	−0.06	−0.54	−0.67	0.00	0.36	−0.39	−0.47
Politicians	−1.49	−1.40	−1.68	−1.67	−1.33	−1.25	−1.44	−1.70

* Rating scale: from −2 to 2, where −2—very bad, −1—bad, 0—neither good nor bad, 1—good, 2—very good. ** The ECB exchange rate is 1 PLN = 0.214 EUR (https://www.ecb.europa.eu, accessed on 13 April 2022). Source: own survey.

Analyses using the χ^2 test show that both the age and education of respondents show a statistically significant relationship with the assessment of many elements of RES support from the municipality, as well as the assessment of the credibility of individual external stakeholders promoting RES among residents (Table 6).

The results of the χ^2, in conjunction with the data presented earlier (Tables 4 and 5), indicate that older adults place relatively higher value on the quality of installation service and technical supervision. They are also more open to independent expert opinions, while having relatively the least trust in companies that provide installation and assembly services. On the other hand, people with better education, in addition to the quality of technical supervision, are relatively more interested in the quality of information and advice on RES and appreciate the possibility to choose and adapt the installation to their own needs.

The χ^2 analysis also confirmed the relationship between disposable income levels and ratings of most elements of municipal support. In conjunction with the respondents' answers (Table 4), it can be inferred that people with lower incomes are positive about the amount of financial support and the resulting benefits of installation in terms of lower energy expenses. In contrast, those with higher incomes are particularly interested in the quality of information, the ability to customize the installation to their needs and the quality of the installation and technical supervision service.

Table 6. Results of χ^2 (p) and C-Pearson (C) tests describing the relationship between the characteristics of respondents and their households and the assessment of the credibility of entities encouraging RES installations and the assessment of selected elements of RES support by municipalities.

Specification	Respondents		
	Age	**Education**	**Income per Capita**
Assessment of selected elements of support for RES investments by the Commune Office			
Methods of informing and encouraging Investment	$p = 0.0030$ C = 0.311	$p = 0.0001$ C = 0.354	$p = 0.0135$ C = 0.248
Quality of consulting	$p = 0.1391$	$p < 0.0001$ C = 0.328	$p = 0.0034$ C = 0.274
Amount of the subsidy	$p = 0.0095$ C = 0.283	$p = 0.0001$ C = 0.314	$p = 0.0001$ **C = 0.327**
Degree of complexity of the documentation	$p = 0.0471$ C = 0.249	$p = 0.0794$	$p = 0.597$
Speed of investment implementation	$p = 0.0079$ C = 0.288	$p = 0.0070$ C = 0.260	$p < 0.0001$ C = 0.353
Flexibility and individual approach to the client	$p = 0.0315$ C = 0.247	$p = 0.0019$ C = 0.285	$p = 0.0019$ C = 0.285
Quality of the offered and installed devices	$p = 0.0705$	$p = 0.0976$	$p = 0.0056$ C = 0.265
Flow of information about progress of investment	$p = 0.5519$	$p < 0.0001$ C = 0.381	$p < 0.0001$ **C = 0.484**
Possibility of choosing the installation to customer expectations	$p < 0.0001$ C = 0.347	$p < 0.0001$ C = 0.373	$p = 0.0522$
Quality of the installation service	$p < 0.0001$ C = 0.356	$p = 0.0147$ C = 0.251	$p = 0.2019$
Quality of technical supervision	$p < 0.0001$ **C = 0.481**	$p < 0.0001$ **C = 0.366**	$p < 0.0001$ C = 0.352
Credibility assessment of the entity encouraging RES installation			
RES supplier/installer	$p < 0.0001$ **C = 0.409**	$p = 0.3537$	$p < 0.0001$ C = 0.398
Representative of the Commune Office	$p < 0.0001$ C = 0.379	$p = 0.0013$ C = 0.291	$p = 0.0406$ C = 0.253
Bank representative	$p = 0.239$	$p < 0.0001$ C = 0.351	$p < 0.0001$ C = 0.407
Representative of the NFEP&WM/PFEP&WM	$p = 0.0016$ C = 0.320	$p < 0.0001$ **C = 0.433**	$p < 0.0001$ C = 0.366
Independent expert	$p = 0.0016$ C = 0.363	$p = 0.0017$ C = 0.291	$p < 0.0001$ **C = 0.450**
Internet publications	$p < 0.0001$ C = 0.386	$p = 0.0002$ C = 0.333	$p = 0.0014$ C = 0.320

p-value of less than 0.05 indicates rejection of the independence hypothesis. Source: own survey.

In terms of RES development support, respondents expect local governments to be very active in obtaining, organizing and transferring financial support (Figure 5). The above concerns the municipality's commitment to umbrella projects for the benefit of residents. In addition, respondents expect to be provided with information on RES funding sources available to households and assistance in gathering the required documentation. Such activities of the municipality received the highest rating (importance) from the residents' perspective. The activities promoting the eco-energy sector, informing about available technical solutions and raising awareness of RES and the benefits of green energy, received intermediate marks. Respondents also expected tax credits for owners of RES installations. However, municipalities have the tax authority limited only to local taxes and thus their capabilities to apply attractive discounts supporting RES among their inhabitants are small.

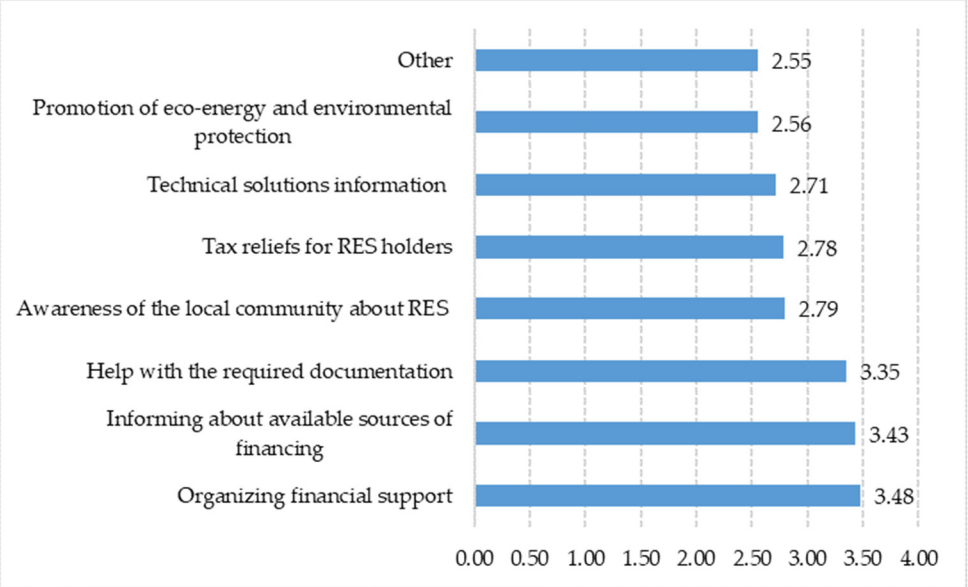

Figure 5. Assessment of the importance of selected Commune Office activities for the RSE development in the "civic" area in the opinion of the respondents. Rating scale: from 0 to 4, where 0—no expectations, 1—small, 2—medium, 3—large, 4—extra-large). Source: own survey.

According to the respondents, the key limitations in the adoption of RES in households are the high installation costs and low profitability of such investments, i.e., long return period (Figure 6). Following these, respondents indicated a lack of support from the local government. This result means that there are still many respondents who do not see the activity of their municipalities in this area or they assess it as insufficient. This was followed again by financial constraints (high cost of credit, unfavorable energy billing system between prosumers and the utility, lack of subsidies and lack of own funds). At the end of the list of constraints were those related to a lack of knowledge and information about RES, or bureaucratic barriers related to obtaining grants. It is worth noting that the potentially greater involvement of the municipality in supporting RES investments may contribute to the reduction of many of the mentioned limitations, both of financial and informational nature.

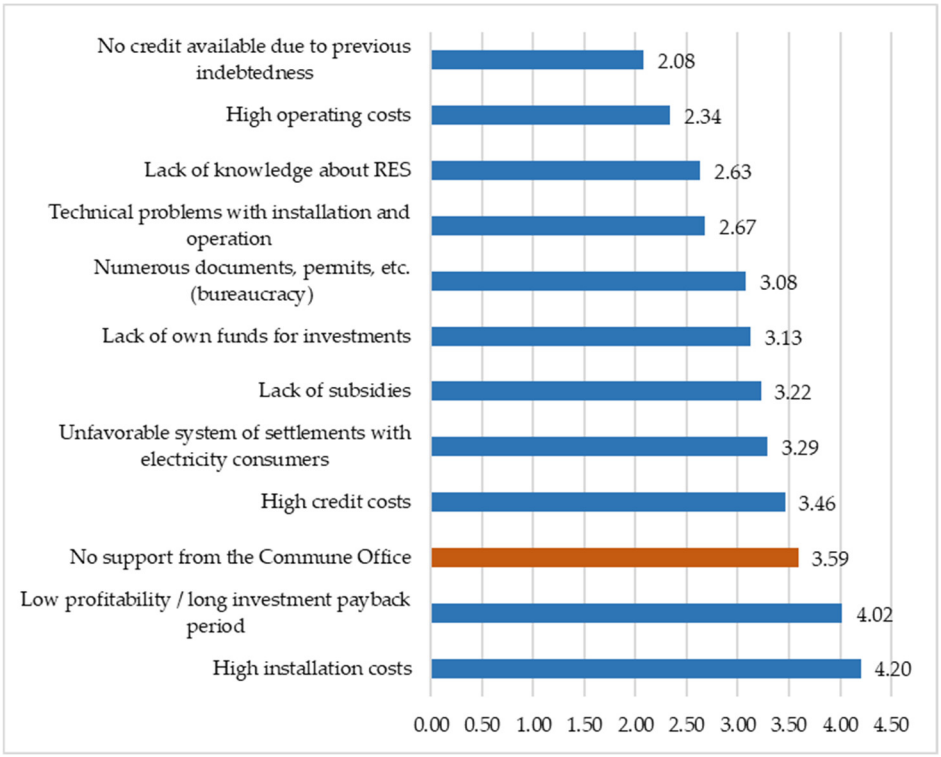

Figure 6. The most important barriers of the RES investments in households according to the respondents, grading scale from 0 points to 5 points, where: 0—no limit; 5—extra-large limitation. Source: own survey.

Relating the research results to others that can be found in the literature, it is worth mentioning a few of them. In the research of the Consumers' Federation in Poland, the greatest barrier to RES installation is too high costs. Such a barrier was indicated by 70% of the respondents [64]. Su et al., presented the results of research for Lithuania, in which the employment status and income level have the greatest impact on the decision related to the purchase of renewable energy sources, and are the most important limitations [65]. Research by Borkowski and Ćwiklińska shows that the most important barrier to the development of renewable energy sources in Poland in the household segment is the insufficient level of support for such investments from public funds, which does not guarantee the profitability of micro-installations. The second most significant barrier was the complex and unclear legal regulations that hinder the implementation of investments, connecting the PV installation to the power grid and discounting the benefits of the installation. The respondents also pointed to the lack of an official register of reliable companies installing micro-installations. Another revealed barrier is the lack of long-term stability and predictability of legal provisions regulating prosumer energy [66]. Moreover, in the research by Siedlecka and Grąszko, financial issues were decisive when it came to making decisions related to the installation of renewable energy sources. In addition to financial factors, the authors of the study pointed to the significant importance of factors such as the technical capabilities of the installation, the complicated connection process to the grid, unclear regulations and the lack of knowledge of renewable energy by household members in Poland [67]. In research by Juszczyk et al., which was conducted in Poland and Finland, key barriers to the installation of RES in households were identified. These barriers are, first of all, the inflexible, ineffective and excessive regulatory framework, limited financing possibilities, as well as a lack of adequate social awareness [68]. Furthermore, the research by Palm for Sweden confirms the greatest financial barriers and complex legal regulations [69].

6. Conclusions

The development of renewable energy sources in the "civic" segment, i.e., for household needs, is a challenge for many institutions. At the local level, local governments have and can continue to play an important role.

In the Podkarpacie region, nearly 40% of RES installations in households living in single-family houses benefited from RES installation grants through the municipality under umbrella projects. Another 8% of RES system users received information and consultancy support in obtaining subsidies from another source. There is also visible activity of municipalities in RES promotion among inhabitants and providing good practices through municipal investments in eco-energy. However, this does not mean that municipalities could not increase their involvement in the area of RES support in the "civic" segment. Residents expect municipalities to be even more active in obtaining funding for RES investments in households, as only some of them have benefited from the umbrella projects so far. The research confirms the great importance of the imitation effect, which causes more residents to be interested in RES investments and to expect support from the municipality. These expectations are not just about co-financing the installation, but also about information and consultancy support.

The research allowed us to accept the hypothesis (H1) that the quality of information on the conditions and benefits of participation in the umbrella project and the efficiency of project implementation increases the likelihood that a household will benefit from the municipality's support in implementing RES technologies. The efficiency of project implementation is related to the time that elapses from the signing of the contract by the project beneficiary to the completion of installation, its acceptance and connection to the network. The shorter this period is, the more willing people are to join the umbrella project. The efficiency balance of RES installations, which is perceived by the users through the prism of reduction of energy bills, is also one of the key determinants.

The activity of the local government in the field of RES support is generally assessed as positive; however, many residents point to certain elements of the municipalities' activities that need improvement. In the case of umbrella projects, this concerns the scale of financial support, the quality of information and advice, the simplification of formal conditions of access to financial support and greater flexibility in the technical parameters of the installations. The most positive evaluations of municipalities' activities in the scope of RES investment support were formulated by decision makers of households aged 60 and more and those representing households with the lowest incomes. These households can be considered most at risk of energy exclusion. Households headed by young people, better educated and with relatively higher incomes, find it easier to obtain support for RES investments offered by various institutions and programs. In the case of elderly, less educated and low-income people, external support in this area (financial, information, consulting) may be indispensable. Therefore, municipalities should focus efforts on supporting households in or at risk of energy poverty.

Local government is an institution that is highly trusted among residents, although ratings of the municipality's credibility in encouraging investment in RES show variation in relation to resident characteristics such as age, education level and income status. Residents' trust in local government can be used to promote RES and the energy transition more broadly, but municipalities' actions in this regard should be diversified, long-term and should take into account the socio-personal characteristics and income of individual recipient groups.

Author Contributions: Conceptualization, R.K., M.L.; methodology, R.K., K.C.; software, S.D., R.P.; validation, R.K., S.D., R.P.; formal analysis, M.L., R.K.; investigation, M.L., R.P.; resources, K.C., S.D.; data curation, K.C.; writing—original draft preparation, R.K.; writing—review and editing, R.K.; visualization, R.P.; supervision, R.K.; project administration, K.C.; funding acquisition, R.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Institute of Economics and Finance, University of Rzeszów.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflicts of interest.

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