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Grants and Funding for the Processes of Decarbonization in the Scope of Sustainability Development—The Case from Poland

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Abstract: The study aimed to determine how the public perceives the directions of decarbonization to develop a sustainable energy strategy for Poland. The political challenge is to use dedicated funds and grants to move from the energy market to low-carbon technology. For sustainable development, governments must implement an environmentally friendly, cost-effective, and socially acceptable policy. The risk of social acceptance plays a vital role in Poland, especially in Silesia, influencing the decarbonization process. The study's main objective was to identify socio-economic features that affect the assessment of the decarbonization process in Poland, assuming that respondents used central or local funds to carry out this process. The authors deepened the multidisciplinary aspect of the analysis of decarbonization, mainly pointing to social issues, which was presented in the article. The study was conducted using the "snowball" method on a group of 444 socially diverse people. They were based on non-parametric statistical methods: Chi-square, Mann–Whitney U, and the Kruskal–Wallis test, which showed that the most effective factors in the decarbonization process are subsidies used by local governments. Moreover, it was found that people with higher education give less support to the centralization of funds for decarbonization, though they perceive that local funds provide a greater chance of success for decarbonization processes. This study fills the gap in social sciences.

Keywords: decarbonization; energy transition; sustainable development; energy policy

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1. Introduction

Europe and the rest of the world are implementing the COP26 Sustainable Development Goals [1–3]. One of the most important decisions for the EU, any government, entrepreneur, or energy consumer, should be the conscious and comprehensive implementation of changes [4]. This also applies to local or local governments' activities, also in the immediate environment, using the principles of sustainable development [5,6]. The goal of sustainability will be achieved when all decision-makers, managers, employees, and citizens are guided by a common idea and begin to use the best tools to achieve a given goal [7], particularly in regards to the environment, people, and efficiency, which will result in a significant improvement in operations and avoiding mistakes, as well as in an increased flexibility, as, for example, during the pandemic [8–11]. Our expectations

for acquisition, the speed of renewable energy sources (RES) development, innovation of energy projects, changes, and energy storage are changing. These changes are prompted by the introduction of new technologies and processes in the energy sector, particularly renewable energy, including prosumers [12–14], cognitive technologies, and the continuous improvement of efficiency and competitiveness [15]. From this perspective, it is necessary to analyze the perception of co-financing from various sources and the relationship between the development of RES in the context of changes in the energy system [16]. These analyses and solutions will help with the assessment of their effectiveness of management, and whether their development is sustainable, despite political and regulatory turmoil. It is worth checking what loads the energy system has when it has to keep up with the changes introduced in producing electricity from renewable sources and the simultaneous implementation of sustainable development principles [17]. The research includes the issues of decarbonization solutions, funds, energy sources, and investment support programs. The research question posed by the authors in this study concerns the identification of the most effective means of financing decarbonization processes. The survey and questions relate to the prospective consumer.

The introduction of renewable energy sources was forced by climate change and the 2030 Agenda [4], as they significantly impact the economies of all countries. The observed global warming affects various sectors of the economy, including the energy sector [6,7,18,19]. We already know how climate change affects our gas and energy bills. The policies of individual countries [20–22], regulatory provisions [23–26], and other documents have an impact on the economy, including energy, transport, and construction [27–32]. These documents should be implemented very carefully, but on the other hand, climate change in the world generates losses of billions of dollars annually [27,33,34], which leads to continued interest in the economy of these changes [35–37]. The changes also concern the energy sector, particularly the costs of transforming coal economies into non-carbon economies and the threats caused by natural disasters [14,38–43]. Therefore, extreme conditions have a specific financial impact on the world economy [27]. Climate change and its related threats affect all sectors of the economy, including the financial sector [19,30,44]. The capacity market, and especially other methods of financing the operating and investment activities of the energy sector, create the risk of reliance on investment portfolios and the loans of financial institutions [45–47].

2. Background

In order to achieve a global temperature increase well below 2 °C, it is necessary to achieve significant reductions in greenhouse gas (GHG) emissions, in line with the climate objective of the Paris Agreement [48]. Such a policy requires a fundamental and multifaceted systemic change to completely decarbonize the global energy system [49]. However, this policy is very complex and highly uncertain [50], and its management creates new threats and opportunities for societies around the world, for example, related to the use of various funds (funds, grants, and subsidies). All countries have a role to play in decarbonizing entire sectors towards climate neutrality.

The time and speed of emission reductions vary from one country's environment to another, including dependence on fossil fuels, ambitions for the energy transition, socio-economic and political context, and capacity to reduce greenhouse gas emissions [51,52]. In recent years, decarbonization pathways have emerged in many sectors, including construction, heating, energy, and transport, and have been driven by technological changes, cost reduction, and the development of the decarbonization technology market. Hydro, wind, and solar energy can be used as examples [53,54].

In such a context, the challenge is to find new methods that are in line with the decarbonization policy, which stands in opposition to a significant group of recipients who have become the subject of the research [55].

The energy sector in Poland should have been undergoing a profound transformation for several years, but this is not the case. The fundamental goal should be to reduce the share

of conventional coal-based energy. All initiatives for RES and other new technologies for its production are being inhibited [56]. As the development of generation sources moves away from centralized generation towards distributed sources, which forces the development of networks, the government, under the pressure of network system operators, slows down these changes by blocking prosumer and investment initiatives. After all, renewable energy sources are slowly becoming increasingly profitable. Of course, they benefit from various support systems, for example, a system of certificates of origin or RES energy auctions [57]. They are being created increasingly often, even without support systems. Significant amounts of them (small power) were also built for individual households. However, beginning in 2022, this process will slow down by introducing unfavorable settlement systems with network operators. The energy consumer becomes a prosumer, but he will resell the energy, and not, as before, use netting systems consisting of the settlement of electricity introduced into the network and consumed for the needs of a given customer [58]. Despite smaller, ever-decreasing support, they are beginning to compete in the market with classic coal-fired power generation technologies. This affects the development and innovation in the area of RES [58] and finally forces a change in the functioning of electricity producers, intensifying their adaptation activities in terms of changing the fuel mix. The proverbial Polish coal-fired power plant is heavily exploited, regardless of the type of coal. The average age is about 40 years. In the past, power plants were designed for continuous operation, with a constant load, without regulation, and with frequent shutdowns. Moreover, the flexibility of coal-fired power plants decreases significantly over time. Their failure rate increases significantly. Failure rate and high costs are not the only problems.

Polish coal-fired power plants have the highest concentration of pollutant emissions. This is a significant deviation from modern norms. The derogation program (schedule of liquidation and shutdowns of the highest emitting energy sources) is in progress, and it will be necessary to turn these sources off; especially those that do not meet the emission standards. Technologically and economically, carrying out a retrofit in many blocks will not be possible. Therefore, the energy system will need new capacities, including nuclear, gas, or hydrogen, that will be compatible with RES and with high regulatory capacity. Despite such a significant development of RES capacity in recent years, Poland still has the highest air pollution among European countries. The country needs many more renewable energy sources, and at the same time, it needs modern energy management systems and changes in networks and smart and cognitive technologies. The energy mix in Poland is shown in Figure 1.

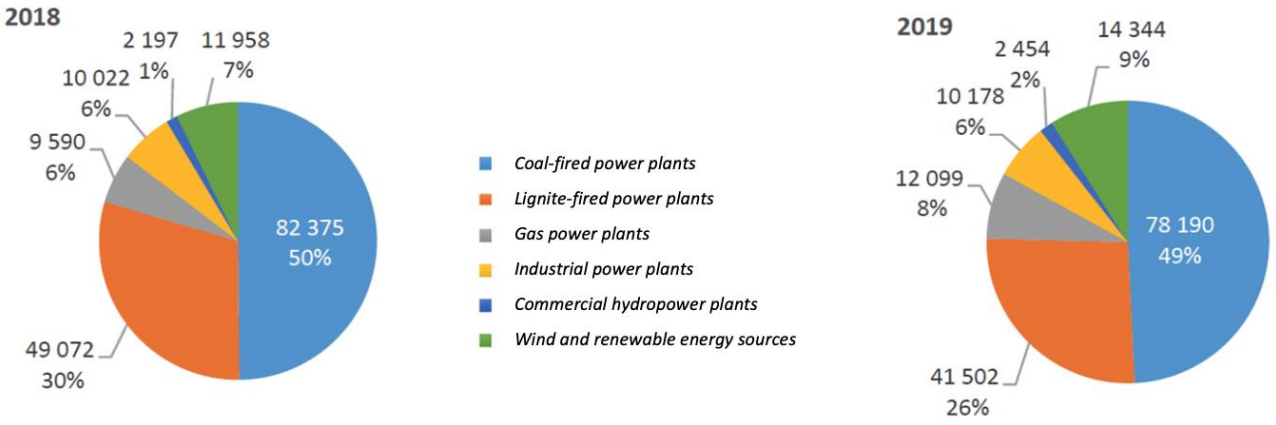

Figure 1. Energy mix—the synthetic structure of electricity production in Poland, year over year, 2018–2019. Source: Report of the President of ERO, May 2020.

Although gas sources may meet the condition of regulatory and frequent shutdowns, they are not the panacea for the need to sustainably develop the energy system in Poland. Energy storage, offshore wind sources, and nuclear energy must also be considered. Only

such a mix will help in sustainable development [59]. Currently, the energy system is struggling with renewable energy, both with its variability and the emergence of distributed sources among prosumers. The chosen direction of changes, i.e., reducing production by prosumers, changing the law to become less favorable for prosumers, do not go hand-in-hand with the principles of sustainable development. Still, the structure of energy production in Poland harms the natural environment.

Comparing these two currents of economics, the subject of mainstream scientific interest is mainly the management of capital. In the case of sustainable development economics, the main area of management is a multidimensional macrosystem covering society, the economy, and the environment. This considers a broad and holistic view of sustainable development economics [60]. As a society, we struggle with social exclusion, hesitation, uneven distribution of prosperity, and insufficient efforts to protect the climate.

Today, any economic growth should lead to greater social cohesion, regardless of its level. It should also take care to improve the quality of the natural environment. While considering climate factors and the fight for climate protection, the fight against social exclusion should not be forgotten. The main tools are to reduce production and consumption's harmful effects and protect natural resources [56]. However, such regulations mainly apply to developed countries [61]. Economic growth that meets the needs of the present generation should not reduce the chances for future generations to meet them [43].

3. Literature Review

Countries around the world have implemented laws and regulations in response to growing concerns about traditional energy consumption [48,49]. Increasingly, more voices are calling for international cooperation and cooperation in solving the problems related to the sale of fossil fuels [50]. The Kyoto Protocol and the Paris Agreement are climate management milestones underpinning the global transition to low-carbon energy [53]. Climate management aims to change the use of non-renewable energy into clean and renewable energy, thereby decarbonizing the economy [54]. International climate agreements reflect the growing global demand for renewable energy development [62], which is also indicated by many energy policies [63].

In the economic sphere, the main challenge is the need for significant low-carbon investments in energy [64–68] which require long-term financing and policies to ensure decarbonization while contributing to economic development. Barido et al. draw attention to the need for support mechanisms with many country-specific factors, and in this context, public acceptance is essential and even required.

Decarbonization can be modeled by "science" and managed by "politics", which increases the awareness that decarbonization is a challenge that has a huge impact on the social sphere—which is proved by the authors of the presented article with their research [65,69–74].

There are also visible actions (related to appropriate management) aimed at changing the purpose of the underground infrastructure, which will affect the minimization of unemployment in mining regions after the end of mining [75–79].

Historically, the area of just transition combined with funds and subsidies began in the 1950s, when the Fund for Retraining and Resettlement of Workers was established within the European Coal and Steel Community [80]. The fund was intended to facilitate the retraining of workers who had lost their jobs due to the development of new technologies [48].

This fund was transformed by the Treaty of Rome (1957) into the European Social Fund (ESF), intended for workers in modernized industries, such as coal mining [48]. The term "just transition" was introduced into the political debate in the 1990s by North American trade unions, aiming to support workers who have lost their jobs due to tightening environmental policy [48]. Subsequent initiatives concerned climate care, which resulted in the long-term decommissioning of fossil fuel-based mines and power plants. The United Nations Framework Convention on Climate Change (UNFCCC), which was one of the

outcomes of the Rio Earth Summit (1992), set the goal of "stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Convention sets out principles, commitments, and ways to achieve them through policies, programs, research, technology, education [81–85], and awareness-raising. It emphasizes the basis of the principles of equity, understood as the division of efforts between less- and more-developed countries [49]. During COP21 in Paris (2015), the Climate Agreement (aka the Paris Agreement) was adopted and recognized as a universal and legally binding act (ratified by 190 countries, including the European Union). The agreement sets out a global action plan to prevent global warming and improve countries' ability to cope with the effects of climate change [50,86]. The implementation of these commitments is to be made possible by the detailed rules contained in the so-called Climate Package (adopted at COP24 in Poland (2018) [53]). At that time, it was argued that the transformation must take place in a fair and solidarity-based manner. The "Guidelines for a Just Transition", published in 2015 by the International Labor Organization, set out a set of principles for transforming economies and societies into an environmentally sustainable model [87–90]. Among the principles, in addition to establishing a comprehensive policy framework, is the need for a strong social consensus on the SDGs and the methods used to achieve them, as well as the need for social dialogue at all stages and levels of governance [54]. In order to ensure a socially fair phase-out of coal, the European Commission established a platform for coal regions in transition in December 2017 [91,92]. The platform aims to support countries, regions, communities, and workers in meeting the challenges of the clean energy transition and the associated economic diversification, especially in cities and metropolises [62]. The Communication on the European Green Deal was issued in 2019 [63]. The current generation's most important task has been to solve climate and environmental problems by using the available funds to facilitate a just transition.

4. Materials and Methods

The main objective of the survey was to determine the socio-economic characteristics affecting the assessment of decarbonization in Poland and the use of central or local funds and subsidies for its implementation.

The study conducted by the authors was three-stage and multi-criteria:

1. Survey research (online survey).
2. Intentional sample selection, using the "snowball" method.
3. The Kruskal–Wallis H Test, the Mann–Whitney U Test, and the Pearson chi-square independence test.

The research used a survey that was conducted using the Computer-Assisted Web Interview (CAWI) technique. The questionnaire filled out by the respondents consisted of twelve questions, including two open questions and a metric, i.e., the respondents' presentation. For most of the questions (questions 1–10), respondents could give one answer, always choosing from five possibilities, assuming that 1 means "does not affect at all", while 5 means "has a significant impact". The individual activities indicated in the survey are assigned one of the following grades: no impact, very little/negligible impact, neutral, visible impact, or significant impact. The manner and content of the presented study were subordinated to the implementation of the assumed purpose of the article.

The sample was selected intentionally, and the "snowball" method was used—a non-random method of selecting respondents for the studied sample. This procedure is appropriate when finding members of a specific population is difficult. In this method, the researcher collects data on several members of the studied population and then asks those individuals to provide the information they need to trace other members of the population that they know.

The Kruskal–Wallis H Test, the Mann–Whitney U Test, and the Pearson chi-square independence test were employed to analyze the study results. Responses were received from 444 people.

The Kruskal–Wallis H Test was used to determine the statistically significant influence of socio-economic characteristics on the selection of activities affecting decarbonization. In order to determine the level of statistical significance of such socio-economic characteristics as age, place of residence, gender, education, and position, the Mann–Whitney U Test and the Pearson chi-square independence test were used to assess whether the relationship or differences between the selected characteristics are statistically significant.

The research was conducted on a group of 444 socially diverse people. The structure of the respondents is presented in Table 1.

Table 1. Characteristics of the surveyed group of respondents.

Feature	N	%	Feature	N	%
Age			Range		
1943–1960 (Baby Boomers (BB))	13	3%	Province	259	58%
1961–1981 (Generation X)	122	27%	entire Poland	96	22%
1982–2000 (Generation Y)	301	68%	European Union	29	7%
since 2001 (Generation Z)	8	2%	Worldwide	60	14%
Place of residence			Gender		
city	317	71%	Male	205	46%
village	127	29%	Female	239	54%
Education			Position		
doctorate	23	5%	director, member of the Management Board	39	9%
higher	154	35%	specialist (junior/senior)	173	39%
higher technical	43	10%	manager (coordinator/manager)	60	14%
higher vocational (bachelor/engineer)	45	10%	non-working person	79	18%
secondary	116	26%	apprentice/trainee	52	12%
secondary vocational	63	14%	owner/co-owner	41	9%

Source: Own study based on research, n = 444.

The analysis includes a numerical and percentage combination and the results of the Mann–Whitney U Test [93–98], the Kruskal–Wallis H Test [99–104], and the Pearson chi-square independence test [93,94,105], allowing an assessment of whether the relationship or differences between the selected characteristics are statistically significant. The significance level $\alpha = 0.05$ was assumed for the study. It is assumed that: when $p < 0.05$, there is a statistically significant relationship (denoted by *); $p < 0.01$ means a highly significant relationship (**); and $p < 0.001$ means a statistically very highly significant relationship (***).

The Mann–Whitney U Test is considered the most effective of the non-parametric equivalents of the t-test for two independent trials. It compares two randomly and independently selected communities in terms of a characteristic measured at least on an ordinal scale and quantitative characteristics with qualitative ones.

The chi-squared independence test (χ^2) compares two or more groups represented by qualitative features.

The Kruskal–Wallis H Test [99–101] is the non-parametric equivalent of a univariate analysis of variance. This test checks whether n independent samples come from the same population or a population with the same median. It relates quantitative characteristics to qualitative ones [102–104].

The presentation of data in the case of such a data collection as those obtained during the research should be performed using the "box-and-whiskers plot" technique, because with this distribution of data, it best presents the results.

5. Results

In one of the questions, respondents were asked to determine the actions they believe could significantly impact decarbonization. The respondents had a choice of five answers, and the statistics of their answers are presented in Table 2:

Table 2. Activities affecting decarbonization (counts) and basic descriptive statistics (mean and standard deviation).

	1	2	3	4	5	$(\bar{x} \pm \sigma)$
Mining subsidy	186	78	83	50	47	(2.31 ± 1.38)
Subsidies for local governments (e.g., for the liquidation of furnaces)	14	40	96	118	176	(3.91 ± 1.12)
Prosumer photovoltaic development programmes	14	46	101	138	145	(3.80 ± 1.10)
Capacity market	33	92	143	124	52	(3.16 ± 1.11)
Opening up the EU energy market	39	58	134	126	87	(3.37 ± 1.19)

Source: Own study based on research, n = 444.

The analysis shows that according to respondents, the most significant opportunities in decarbonization may bring financial incentives in the form of subsidies that local governments would use to change infrastructure, e.g., liquidating high-emission furnaces. The gradation of the answer to this question is shown in Figure 2:

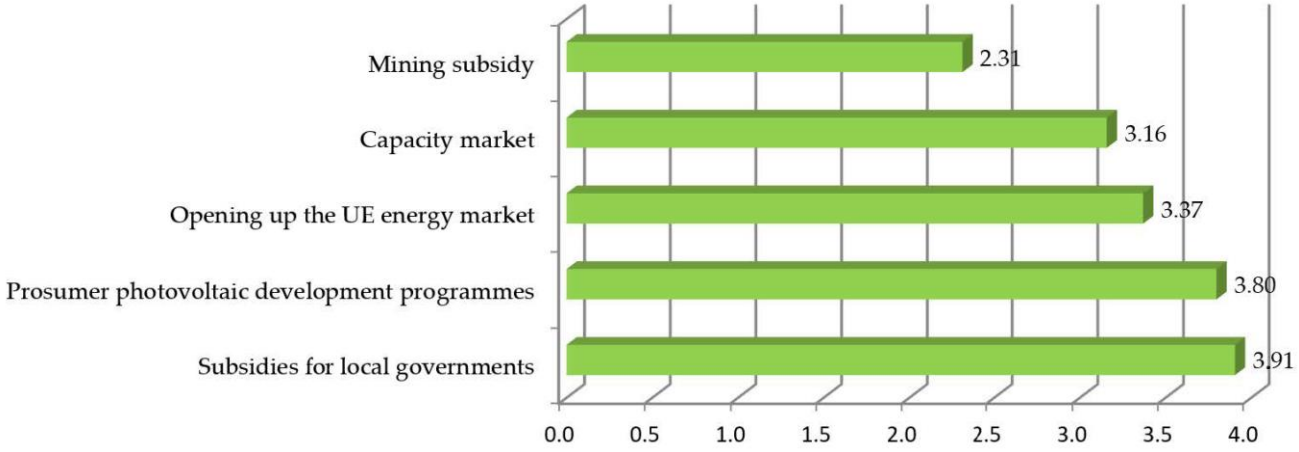

Figure 2. Activities affecting decarbonization—average assessments of individual factors. Source: Own study based on research, n = 444.

Socio-economic features were analyzed in developing the research results, which may affect the opinion expressed by respondents when determining the activities affecting decarbonization. The Kruskal–Wallis H Test was used to determine the statistically significant influence of socio-economic characteristics on the selection of activities affecting decarbonization. The level of statistical significance of these characteristics is shown in Table 3:

Table 3. Selection of individual decarbonization activities by respondents and their socio-economic characteristics.

	Age	Place of Residence	Gender	Education	Position	Range
			p			
Mining subsidy	0.0406	0.1035	0.0000	0.0057	0.0002	0.0047
			p			
Subsidies for local governments (e.g., for the liquidation of furnaces)	0.2866	0.3764	0.0004	0.7446	0.3236	0.5246
Prosumer photovoltaics development programmes	0.2940	0.9284	0.9142	0.0707	0.0676	0.5745
Capacity market	0.2977	0.7126	0.4198	0.6038	0.1547	0.3263
Opening up the EU energy market	0.3658	0.3820	0.6852	0.7827	0.6763	0.5331

Source: Own research based on the study conducted using the Kruskal–Wallis H Test and Mann–Whitney U Test, n = 444.

Additionally, this study determines the impact of individual socio-economic traits on assessing the individual activities' influence on decarbonization. The research shows that the place of residence did not affect the assessment of any factor, and the respondents' age impacted only the assessment of the importance of subsidies for mining $p < \alpha$ ($p = 0.0406$). The respondents' gender had an impact on the assessment of subsidies for mining $p < \alpha$ ($p = 0.0000$) and local governments $p < \alpha$ ($p = 0.0004$). The respondents' education had an impact on the assessment of subsidies for mining $p < \alpha$ (p = 0.0057), as well as the taken position $p < \alpha$ ($p = 0.0002$) and the respondents' scope of business activity $p < \alpha$ ($p = 0.0047$).

In order to determine the importance of central and local funds supporting the decarbonization measures identified by the respondents, they were asked which of these activities should be financed from local funds (such as funds at the disposal of local authorities at least at the regional level, without specifying their source) and which should be financed from central funds (for instance, from European Union or country level).

Respondents could indicate five answers when answering a question about actions financed from local funds. The number of answers to this question is shown in Figure 3:

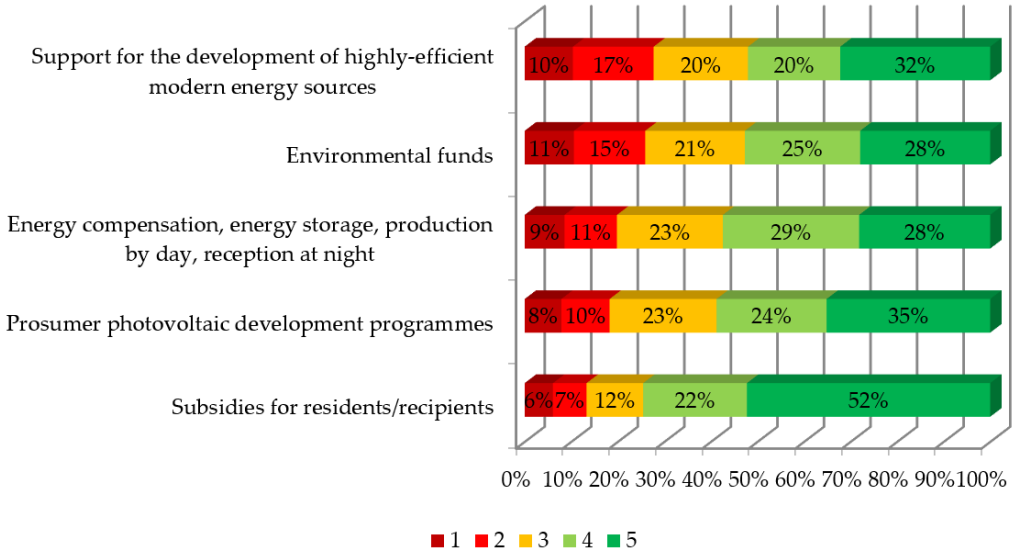

Figure 3. Which decarbonization activities should be financed from local funds. Source: Own study based on research, n = 444.

Descriptive statistics for respondents' answers to this question was also specified. The mean response and standard deviation are shown in Table 4:

Table 4. Evaluation of decarbonization activities to be financed from local funds (counts) and basic descriptive statistics (mean and standard deviation). Source: Own study based on research, n = 444.

	1	2	3	4	5	$(\bar{x} \pm \sigma)$
Subsidies for residents/recipients (e.g., for the decommissioning of furnaces)	27	32	54	99	232	(4.07 ± 1.22)
Prosumer photovoltaic development programmes	35	46	102	105	156	(3.78 ± 1.27)
Energy compensation, energy storage, production by day, reception at night	38	50	101	130	125	(3.57 ± 1.25)
Support for the development of highly-efficient modern energy sources (e.g., cogeneration bonus, RES)	46	77	90	88	143	(3.46 ± 1.37)
Environmental funds	47	68	95	110	124	(3.44 ± 1.32)

The research shows that respondents consider subsidies for infrastructure changes—e.g., changes in high-emission individual heat sources and support for the development of prosumer energy, such as photovoltaics—the most advantageous form of decarbonization activities that should be financed from local funds. The gradation of the answer to the question on actions financed from local funds is shown in Figure 4:

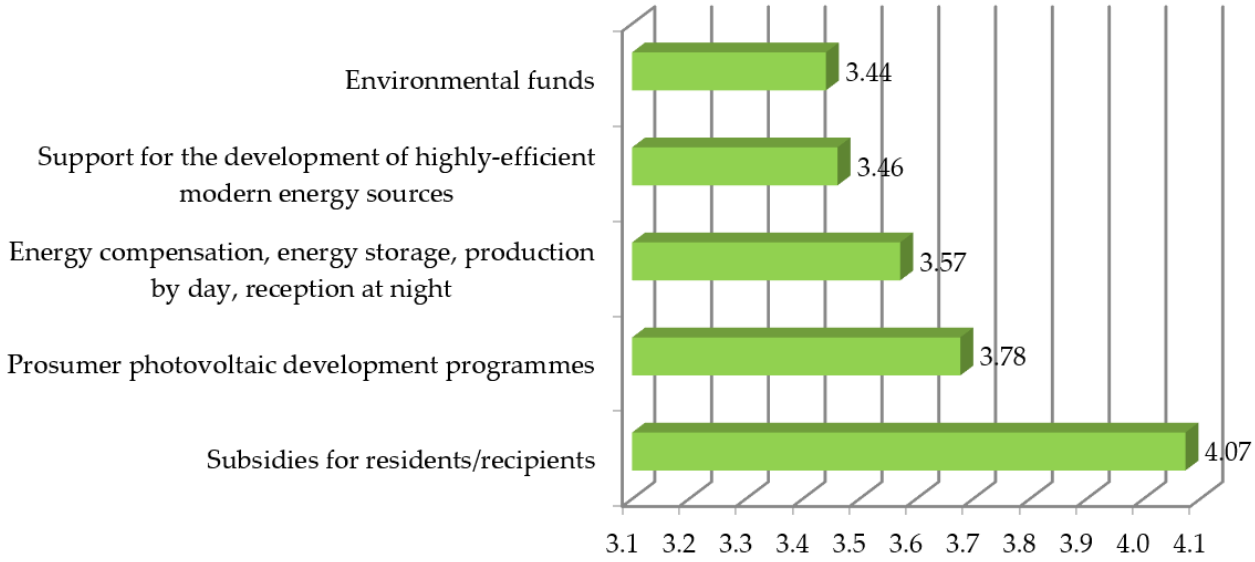

Figure 4. Evaluation of decarbonization activities that should be financed from local funds—ranking—average ratings. Source: Own study based on the conducted research, n = 444.

It was also checked whether socio-economic characteristics, i.e., age, place of residence, gender, education, position, and scope of activity, impact the assessment of activities that should be financed from local funds (transferred from the central to the local level). The research shows that the position and scope of respondents' business activity do not affect the assessment of these factors. The results are given in Table 5.

Age was related to the assessment of prosumer photovoltaic development programmes $p < \alpha$ ($p = 0.0025$), place of residence with the assessment of environmental protection funds $p < \alpha$ ($p = 0.0408$), gender with an assessment of energy compensation, energy storage, production during the day and reception at night $p < \alpha$ ($p = 0.0044$), and with support for the development of highly-efficient modern energy sources $p < \alpha$ ($p = 0.0270$). The education was related to the assessment of subsidies for residents—recipients $p < \alpha$ ($p = 0.0402$) and with the assessment of the prosumer photovoltaic development program $p < \alpha$ ($p = 0.0002$).

Table 5. Assessment of individual factors and socio-economic characteristics. Source: Own research based on studies conducted using the Kruskal–Wallis H Test and Mann–Whitney U Test. n = 444.

	Age	Place of Residence	Gender	Education	Position	Range
			p			
Grants to residents/recipients (e.g., for the decommissioning of furnaces)	0.0504	0.0790	0.1380	0.0402	0.1380	0.6751
Prosumer photovoltaic development programmes	0.0025	0.1406	0.6599	0.0002	0.1096	0.3373
Energy compensations, energy storage, production by day, reception at night	0.3803	0.0538	0.0044	0.5841	0.2481	0.2112
Support for the development of highly-efficient modern energy sources (e.g., bonus cogeneration, RES)	0.0674	0.4993	0.0270	0.7434	0.7691	0.0640
Environmental funds	0.4684	0.0408	0.0894	0.6243	0.8393	0.1474

To more accurately present the relationships between individual activities—which respondents believe should be financed from local funds—and the socio-economic features, these relationships are shown by box-and-whiskers plots. The first statistically significant relationship was the age of respondents in the assessment of photovoltaic installations as a decarbonization activity. The response statistics are shown in Figure 5.

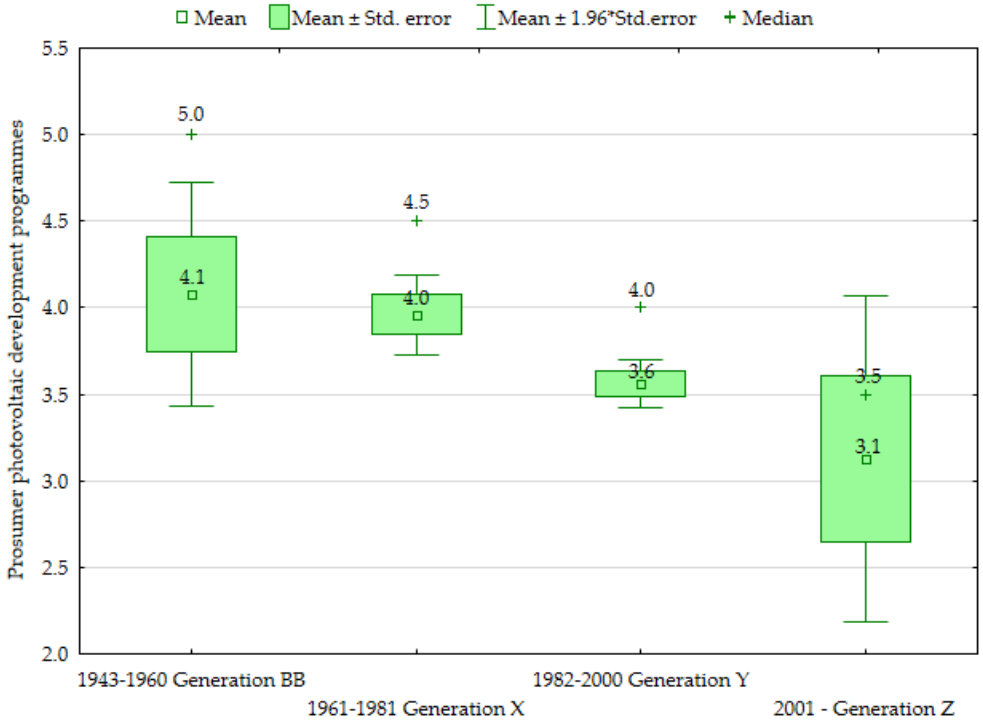

Figure 5. Age of respondents and their assessment of the prosumer photovoltaic development programme. Source: Own study based on the conducted research. n = 444.

The graph shows that the most significant dependence occurs in the group of the oldest respondents, which was a surprise for the authors, who expected that it would be young people who paid attention to renewable energy. In the authors' opinion, this statement may result from the fact that young people usually do not own real estate, especially houses, and are not interested in photovoltaic installations. Generally, young people live in multi-family buildings where the installation of photovoltaic cells requires the cooperation of many people. Based on these research results, a recommendation can be presented to increase funds for social programmes. Their task will be to educate the societies of individual

European Union countries on the possibility for using renewable energy sources at the prosumer level.

Another statistically significant relationship was the place of residence and the respondents' assessment of the impact of environmental protection funds on decarbonization. These relationships are shown in Figure 6.

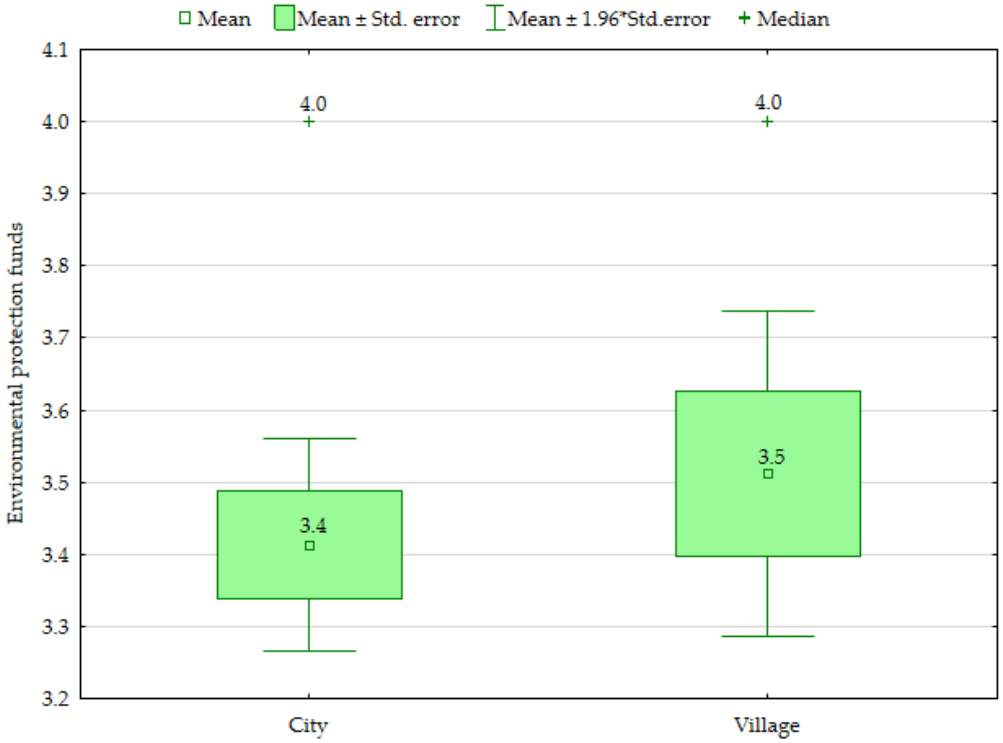

Figure 6. Place of residence and assessment of the importance of environmental protection funds. Source: Own study based on the conducted research, n = 444.

Research shows that using environmental protection funds in decarbonization is more important to rural residents, which means that they look at decarbonization as a more social undertaking, not as an individual undertaking, as do city dwellers.

The respondents' gender was statistically significant in the assessment of the impact of two actions on decarbonization:

- Energy compensation, energy storage, production by day, and reception at night.
- Support for the development of highly efficient, modern energy sources (e.g., cogeneration bonus, RES).

These relationships are shown in Figures 7 and 8.

The analysis of gender's impact on the assessment of these decarbonization activities indicates [106] in these two cases that women consider these activities more important for decarbonization. In the authors' opinion, this is due to women's and men's generally different attitudes about environmental protection. Women care more about the quality of life.

The impact of education on assessing financial incentives for decarbonization activities by respondents was also statistically significant. A particularly strong dependency occurred in the case of support for photovoltaic programmes (p = 0.0002). The distribution of responses is shown in Figure 9.

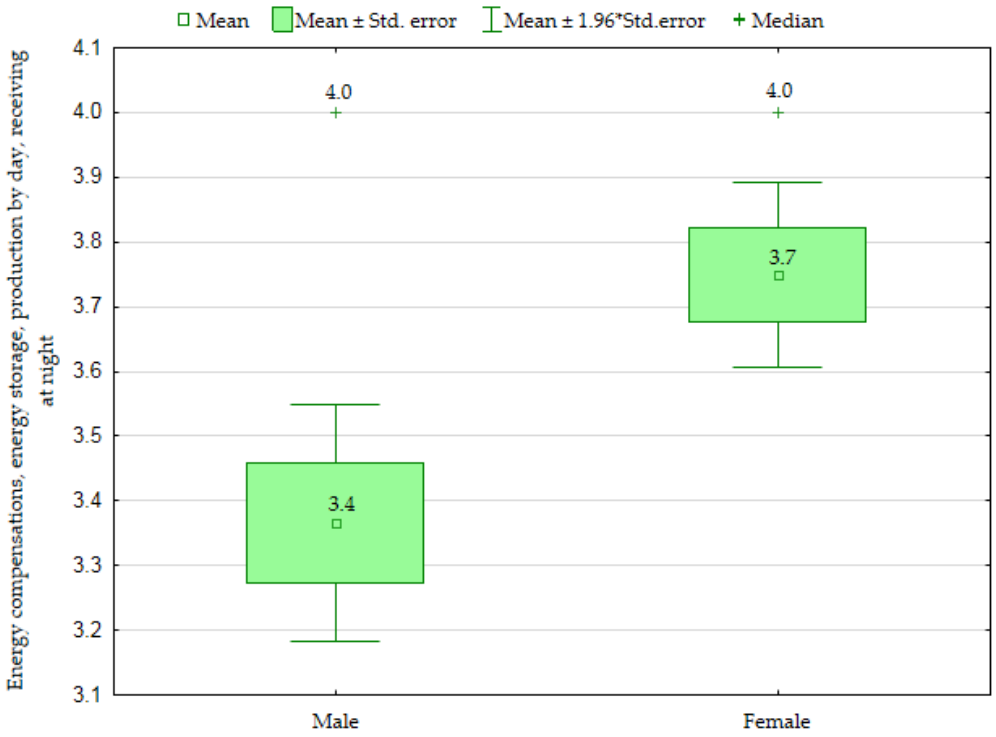

Figure 7. Gender and the assessment of energy compensation. Storage of production by day, receiving at night. Source: Own elaboration based on the conducted research, n = 444.

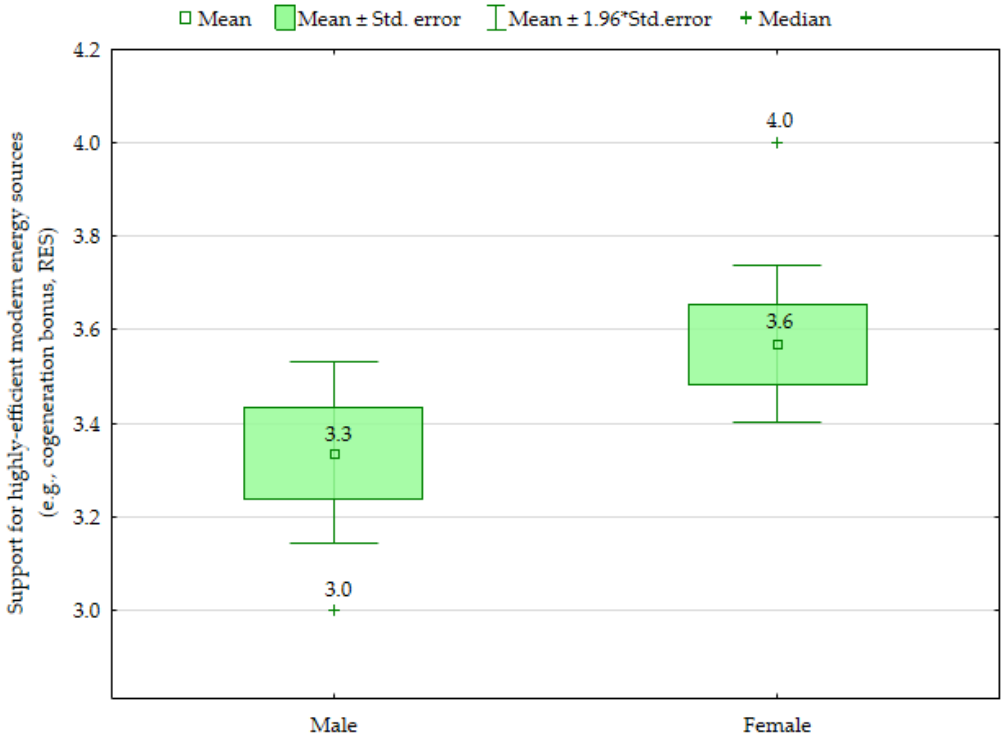

Figure 8. Gender and the assessment of support for the development of highly efficient, modern energy sources (e.g., cogeneration bonus, RES). Source: Own elaboration based on the conducted research, n = 444.

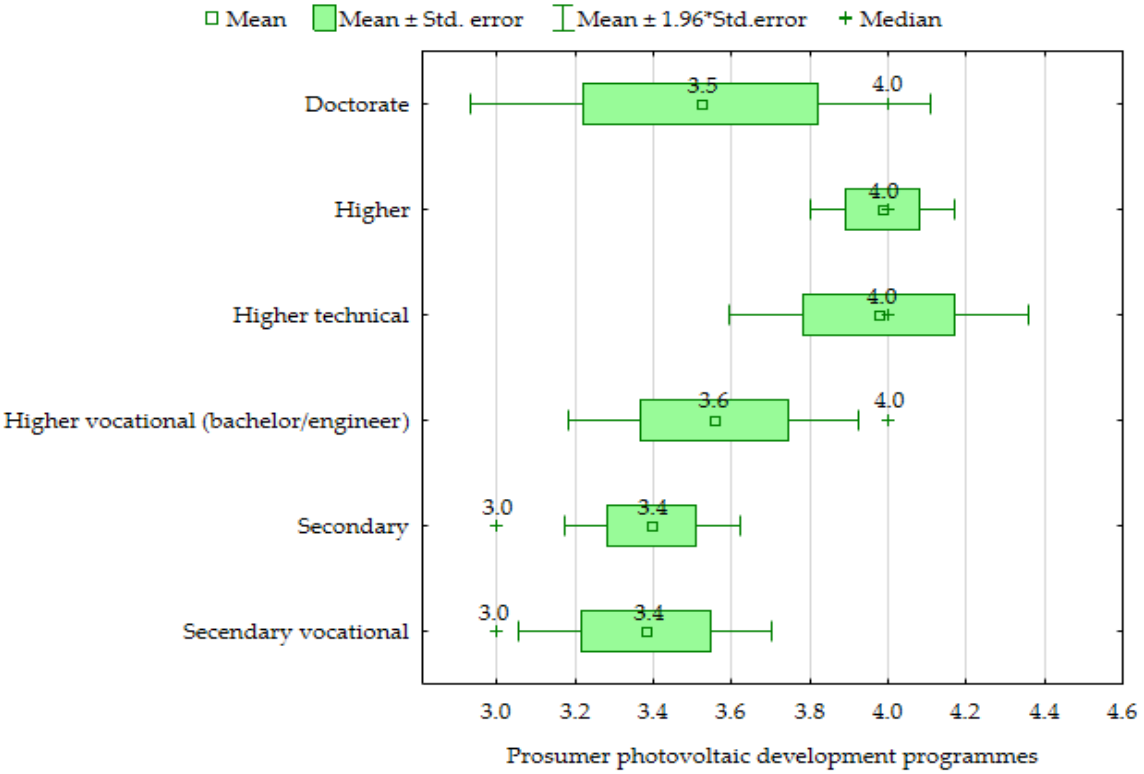

Figure 9. Impact of education on the evaluation of prosumer photovoltaic development programmes in decarbonization. Source: Own elaboration based on the conducted research, n = 444.

The analysis shows that in the opinion of respondents, the higher the education, the more important the development of prosumer photovoltaics for decarbonization. Respondents with a doctoral degree break out of this trend, but their share in the total number was relatively small (5%).

Summing up this part of the research, it can be said that respondents believe that financial incentives have the highest potential to carry out decarbonization efficiently, especially in the form of subsidies for the change of individual heating infrastructures or the development of prosumer photovoltaics.

Respondents also believe that the distribution of funds supporting decarbonization should be handled by the local structures of individual European Union countries at the regional level or even smaller local government units.

These findings are even more accurately presented in the statistics of respondents' responses to the next question of the survey regarding the legitimacy of the centralization of funds intended for decarbonization in the European Union countries.

It was checked whether age and education impact the assessment of the legitimacy of centralization of funds for decarbonization from the perspective of its effectiveness. The research shows that both socio-economic characteristics significantly impacted the assessment of the appropriateness of centralizing decarbonization funds from the perspective of its effectiveness. The results are presented in Table 6.

Table 6. Assessment of the appropriateness of centralizing decarbonization funds from the perspective of its effectiveness and socio-economic characteristics.

	p
Age	0.0000
Education	0.0002

Source: Own research based on the study conducted using Pearson's chi-square independence test, n = 444.

Both age and education differentiate the assessment of the legitimacy of centralizing funds for decarbonization from the perspective of its effectiveness. The case of the influence of the respondent's age on the assessment of the effectiveness of centralization of funds on decarbonization is presented in Figure 10.

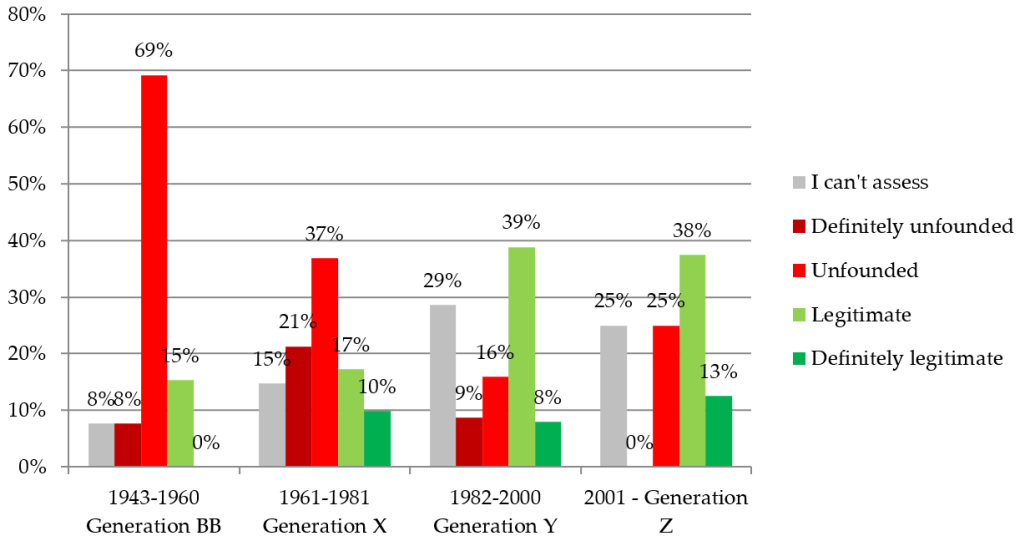

Figure 10. Age and the assessment of the legitimacy of centralization of funds for decarbonization from the perspective of its effectiveness. Source: Own study based on the conducted research, n = 444.

The assessment of the legitimacy of centralizing funds intended for decarbonization (Figure 11) due to the age of respondents, to some extent, coincides with their assessment of support for the development of prosumer photovoltaics, since, also in this case, the higher the age of the respondents, the less likely they are to see the centralization of funds earmarked for decarbonization as legitimate [107]. This is probably due to the financial commitment of respondents to developing their quality of life.

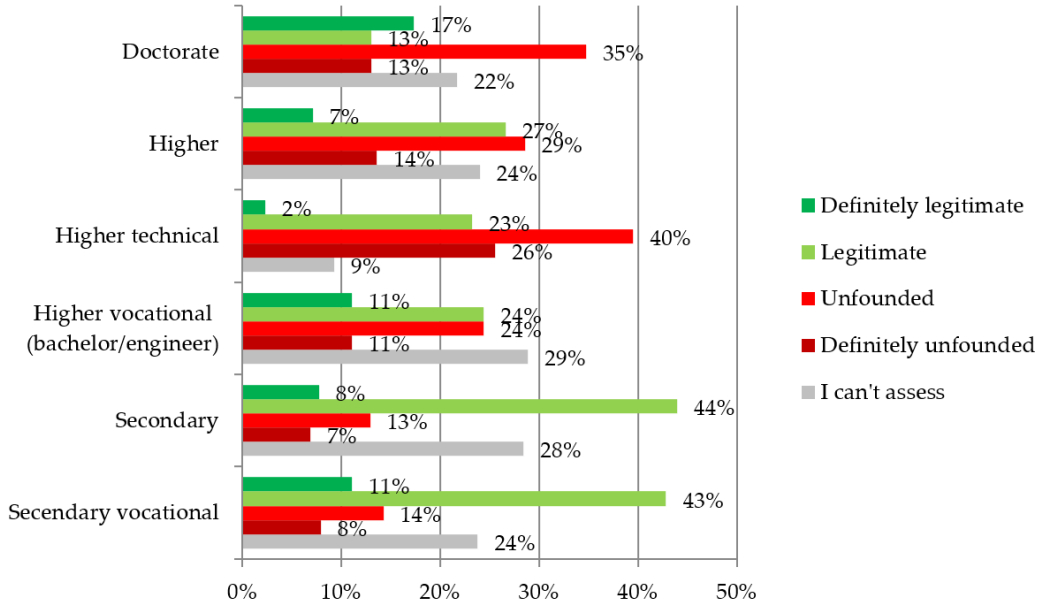

Figure 11. Education and assessment of the legitimacy of centralization of funds for decarbonization from the perspective of its effectiveness. Source: Own study based on the conducted research, n = 444.

The respondents' education also influenced the assessment of the legitimacy of the centralization of funds for decarbonization. The statistics of this relationship are presented in Figure 11.

The results of the study carried out on a group of 444 socially diverse people showed that the best opportunities for decarbonization might come from subsidies used by local governments. The selected socio-economic features of the group analyzed determined the impact of individual decarbonization activities on the respondents' opinions. Namely, the place of residence did not affect the assessment of any factor. The age of the respondents only influenced the assessment of the importance of subsidies for the mining industry. The gender of the respondents influenced the assessment of subsidies for mining and subsidies for local governments. On the other hand, the education, position, and scope of the respondents' activity influenced the assessment of subsidies for the mining industry. The respondents believe that financial incentives in the form of subsidies to change individual heating infrastructures or the development of photovoltaics have the best opportunities for the efficient implementation of decarbonization. The surveyed group also believes that the distribution of funds supporting this process should be handled by the local structures of the EU countries. The age of the respondents and their education had an impact on the legitimacy of centralizing funds for decarbonization from the point of view of its effectiveness. Thus, the conclusion is that the higher the education, the less support for the centralization of funds for decarbonization, while respondents with higher education see better opportunities for the success of decarbonization in the example of Poland.

6. Conclusions

The research question posed by the authors in this study concerns the identification of the most effective means for financing decarbonization. The survey and questions relate to the prospective consumer. The respondents believe that financial incentives in the form of subsidies to change individual heating infrastructures or the development of photovoltaics provide the best opportunities for the efficient implementation of decarbonization.

Thanks to the EU's cohesion policy, EU countries, regions, local authorities, and cities can make major investments contributing to the European Green Deal. They must spend at least 30 percent of the money they receive from the European Regional Development Fund on these priorities. In addition, 37% of the Cohesion Fund will contribute primarily to achieving climate neutrality by 2050.

As part of the Green Deal, the Commission has introduced an investment plan for a European Green Deal, also called the Sustainable Europe Investment Plan. It includes the Fair Transition Mechanism, which aims for a fair transition towards a green economy. In 2021–2027, it will mobilize significant investment to support citizens in the regions most affected by the transition [108].

Climate risk, including the need for investment in RES, forces indications on the means by which funds should finance investments. Centralization of funds serves neither the development of investments nor their proper distribution. It is, of course, necessary to control their use, but it is the distribution of these funds that will affect not only the country's climate policy, but also the development of entrepreneurs. It is important from the point of view of strategic planning and creating the future of enterprises and financial institutions in the era of radical changes to their functioning resulting from the implementation of global climate goals. It is necessary to identify tools that will allow decision-makers to find ways to adapt the functioning of the entities they manage to the business conditions in the green transition, and to apply green finance instruments to meet the emerging challenges and adapt the functioning of their organizations to the drastically changing business conditions.

The authors also decided to conduct further research in the form of a project on the possibility of distributing funds and their use locally through local governments. The question arises not only about the level of distribution of funds, but also about the form of support given to businesses and green investments. In the authors' opinion, it is difficult to agree with the research that subsidies for recipients are the most effective. They are the

most desirable, but are they effective? It would be necessary to conduct further research on this matter in order to avoid leading the state economy to the point that there would be no investment in RES if the recipient did not get the subsidy—this is a social issue—the habit of "taking".

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