

## ATTITUDES OF HOUSEHOLDS AS ENTITIES INVESTING IN GREEN INFRASTRUCTURE COMPONENTS

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**Purpose:** The study focused on two distinct research areas: the first focused on the attitudes of households as investors in green infrastructure components. The second focused on understanding the attitudes of households as citizens—recipients of green infrastructure provided by local government units. The study had three main objectives. The first was to assess household knowledge and attitudes regarding "green" investments. The second objective was to identify barriers and expectations regarding forms of support for "green" investments undertaken by households. The third objective involved understanding household attitudes towards "green" investments undertaken by local government units.

**Design/methodology/approach:** The research was conducted using a survey questionnaire. Data were collected using the CAWI method. The survey consisted of 60 questions. The target group of participants were representatives of households residing in Poland. The research sample was N = 1000. The survey was anonymous.

**Findings:** The conducted research enabled the formulation of conclusions supporting the process of designing policy instruments and tools for "green" investments that are appropriate to the needs expressed by households.

The study also provided conclusions regarding household preferences for "green" investments provided by local government units.

**Research limitations/implications:** The research results presented in this article are geographically limited to Poland, and subjectively limited to households. Furthermore, the presentation of results is subject-specifically limited to one component of "green" investments: photovoltaics.

**Practical implications:** Gathering knowledge about the attitudes of households towards "green" investments will contribute to supporting decision-making processes at the national level and at the level of cities and municipalities, including the GZM Metropolis, for a more effective implementation of the energy transformation of the country and regions.

**Social implications:** Identifying household attitudes toward "green" investments will enable the adaptation of policy instruments and tools at the national and regional levels to the expressed expectations. Furthermore, the research findings will allow for the identification of household expectations regarding "green" investments provided by local government units.

**Originality/value:** The development of knowledge regarding the attitudes of households towards "green" investments (private and public) will make it possible to fill the cognitive gap in the above-mentioned research area, and will also contribute to the economics of climate change by diagnosing the existing state of affairs, expanding knowledge and identifying new research directions.

**Keywords:** green investments, sustainable development, green infrastructure, photovoltaic panels.

**Category of the paper:** research paper.

## 1. Introduction

Climate change is a priority for European Union institutions, EU Member States, and individual regions. The European Green Deal, launched in 2019, has prompted further action at the EU level to achieve the goal of achieving climate neutrality by 2050. (Communication from the Commission, 2019). In this respect, one of the key elements of the European Green Deal is the European Climate Law, which was adopted in 2021. (Regulation EU 2021/1119, 2021). These provisions are intended to help achieve the overall goal of climate neutrality by 2050, as well as implement a new target of reducing net greenhouse gas emissions in the EU by at least 55% by 2030 compared to 1990 levels. Furthermore, in 2024, the European Commission recommended an additional intermediate climate target of reducing net GHG emissions by 90% by 2040 compared to 1990 levels. In turn, in the field of energy from renewable sources, the agreement on the revised Renewable Energy Directive sets a binding EU target of at least 42.5% share of renewable energy in final energy consumption by 2030. (Directive EU, 2023/2413, 2023). The revised target assumes doubling the share of energy from renewable sources in the EU energy mix in relation to previously formulated targets in this area.

Referring the above to the structure of electricity generation in Poland in 2023, the share of energy generated by hard coal and lignite-fired power plants dominates, accounting for over 60% of the country's electricity production. (Energy 2024, 2024). According to the same source, the share of photovoltaic installations in energy production is approximately 7% of Poland's overall energy mix (excluding thermal energy production). This situation poses a significant challenge for both the government and local government authorities, as well as the Metropolis GZM.

At the national level, the main documents shaping the adopted energy strategy are the "Poland's Energy Policy until 2040" (Polityka Energetyczna Polski Do Roku 2040, 2021), which will be updated due to changes in the political and economic situation. The second document defining the country's energy transformation is the "National Energy and Climate Plan for 2021-2030" (Krajowy Plan w Dziedzinie Energii i Klimatu na lata 2021-2030, 2019) with two amendments from 2024 (Projekt Krajowego Planu, luty 2024; Projekt Krajowego Planu, październik 2024).

Transferring further considerations to the functioning of the Upper Silesian-Zagłębie Metropolis (GZM), as stated in the Diagnosis of the State of GZM, "GZM faces the challenge of carrying out a just transformation, including energy transformation, requiring social, economic and technological changes, as well as replacing high-emission industries and energy

sources with clean energy technologies" (Opracowanie Strategii Rozwoju Górnośląsko-Zagłębiowskiej Metropolii, 2022, p. 250), which requires huge investment outlays.

In the Development Strategy of the Upper Silesian-Zagłębie Metropolis for 2022-2027, with a perspective until 2035, among the development challenges 1 are indicated within the objectives of priority A, in particular: A.1. Development and management of blue-green infrastructure and A.2. Energy transformation and improvement of air quality (Strategia Rozwoju GZM na lata 2022-2027, 2022).

In turn, in the Development Strategy of the Silesian Voivodeship "Śląskie 2030" - Green Silesia within the framework of Strategic Objective A, it was decided: The Silesian Voivodeship as a region of responsible economic transformation (Strategia Rozwoju Województwa Śląskiego, 2020).

According to the provisions of the Regional Innovation Strategy of the Silesian Voivodeship 2030 - the Silesian Voivodeship "(...) faces the challenge of carrying out the process of economic transformation from an energy- and resource-intensive economy, based on traditional fossil fuels, towards a sustainable, low-emission, closed-loop economy" (Regionalna Strategia Innowacji Województwa Śląskiego 2030, 2021).

Implementing the energy transformation process in line with the adopted assumptions requires large-scale investment and the involvement of the widest possible range of investors.

Given the above, it is justified to assess household attitudes towards private and public "green" investments to enable their involvement in financing the transformation process, as well as to identify their expectations of the state and local government units in this regard.

In the literature, the issue of investors' attitudes towards "green" investments, as well as barriers and expectations, has been the subject of research both in foreign literature (Zeru, Guta, 2021; Sun et al., 2018; Palm, 2018) and domestic literature (Juszczak et al., 2022; Dąbrowska et al., 2021; Stanisławska, 2023).

However, a literature review led to the conclusion that there is a lack of comprehensive research conducted on a representative national sample regarding the knowledge and attitudes of households towards investing in photovoltaic installations in Poland. The research conducted allowed us to understand the knowledge and attitudes of Polish households towards investing in photovoltaics, as well as to identify the main barriers and expectations of households related to investing in photovoltaics. These results expand this knowledge and provide a basis for formulating proposals for forms of support for "green" investments tailored to household needs.

This article formulates three research objectives. The first is to assess household knowledge and attitudes toward "green" investments. The second is to identify barriers and expectations regarding forms of support for "green" investments undertaken by households. The third objective involves understanding household attitudes toward "green" investments undertaken by local government units.

Achieving these goals can contribute to shaping instruments supporting "green" investments and policy tools in this area at the national and regional levels, in a manner that is adequate to the expectations expressed by households, thus increasing households' willingness to invest in "green" infrastructure components. Furthermore, the research results will allow for the identification of household expectations regarding "green" investments provided by local government units.

For the purposes of the study, the following research questions were formulated:

1. What is the attitude of households towards investing in photovoltaics?
2. What is the knowledge of households about investing in photovoltaics?
3. What are the main barriers to households investing in photovoltaics?
4. What are household expectations regarding the forms of support for investing in photovoltaic installations?
5. Do households support local governments investing in photovoltaics?

The research was conducted using the CAWI method. A 60-question survey questionnaire was designed for the study. Representatives of households residing in Poland were selected as the survey respondents (the research sample included 1000 household representatives).

## **2. Literature review**

Energy transformation is one of the greatest challenges facing Poland's economy today. This is due to the ambitious climate policy goals being developed by the EU. The importance of this issue is underscored by the fact that the economy relies heavily on conventional energy sources. According to McKinsey & Company, electricity demand is projected to increase 2.4 times in 2050 compared to 2020 levels (Engel, Purta, Speelman et al., 2020). Additionally, the problem is exacerbated by difficulties related to the implementation of investment projects in the field of climate-resilient infrastructure (Mrozowska et al., 2021). As emphasized in the literature, large-scale investments are necessary to enable the energy transformation and adaptation to the EU goals (Kundzewicz, Matczak, 2012). The CAKE report presents scenarios relating to the way of implementing Poland's energy transformation in the perspective outlined by the EU, which at the same time meet the EU requirements regarding the share of renewable energy sources in the energy mix in 2050 (Tatarewicz, Lewarski, Skwierz et al., 2022). According to a report by McKinsey & Company, solar energy could account for approximately 13% of the total electricity supply in 2050 (Engel, Purta, Speelman et al., 2020). Ensuring the achievement of EU climate goals will require the implementation of renewable energy projects, such as onshore and offshore wind energy, and prosumer photovoltaics. In terms of photovoltaic investments, it will be necessary to engage both public and private sector entities, including households, in financing photovoltaic installations.

In the literature on the subject, the issue of investing in photovoltaics is considered in various contexts: economic, environmental, social (Mauleón, 2017). Numerous studies address issues related to willingness to pay for photovoltaic installations – WTP (Bragolusi, D’Alpaos, 2021; Skordoulis et al., 2020; Lee et al., 2018; Ugulu, Aigbavboa, 2019). A key issue is shaping policy to support renewable energy markets, particularly photovoltaic investments. The authors point out that political stability is a key aspect supporting this type of investment (Assereto, Byrne, 2020). In many studies, the authors review the state of development of photovoltaic investments, including a review of experiences in the field of government interventions, as well as their comparison on an international scale (Huo, Zhang, 2012; Moosavian et al., 2013). Some authors emphasize that investments in household photovoltaics can make a significant contribution to decarbonization. Research results indicate the need to reduce political uncertainty regarding incentive programs for these investments (Petrovich, 2021; Zhang et al., 2025).

In foreign literature, the issues of investors’ knowledge and attitudes towards “green” investments have been the subject of research undertaken by many authors (Zeru, Guta, 2021; Sun et al., 2018; Palm, 2018). In Poland, research was conducted on selected aspects of the behavior and attitudes of Polish investors towards photovoltaic installations (Dąbrowska et al., 2021; Stanisławska, 2023). Grębosz-Krawczyk et al. examined factors influencing consumer behavior towards green energy (Grębosz-Krawczyk et al., 2021). Research on factors shaping investment intentions in prosumer PV technology was conducted by Mularczyk et al. (Mularczyk et al., 2022), as well as Wicki et al. (Wicki et al., 2022). Igliński et al., in turn, examined the potential, prospects, and development of photovoltaic installations (Igliński et al., 2022).

In the context of barriers and investor expectations regarding forms of support for "green" investments, research was conducted by, among others, Rataj et al. (Rataj et al., 2021). The results of these studies provided proposals for shaping selected aspects of energy policy at the EU, national, and regional levels. Barriers to implementing investments in renewable energy sources, using the examples of Poland and Finland, were the subject of research by Juszczak et al. (Juszczak et al., 2022). Wardal et al., in turn, presented the results of research on barriers to the development of green energy in Germany, Italy, Spain, and Poland (Wardal et al., 2024). Research on the main determinants of the development of the broadly understood photovoltaic industry in Poland is presented by Błaszczak et al. (Błaszczak et al., 2024).

A review of the literature leads to the conclusion that there is a lack of comprehensive research conducted on a representative national sample regarding the knowledge and attitudes of households towards investing in photovoltaic installations in Poland. According to our findings, there is also a lack of nationwide research on the barriers and expectations of households as investors in photovoltaic installations. The literature study also leads to the conclusion that there is a lack of research presenting household attitudes towards investing in photovoltaic installations by local government units.

Taking into account the diagnosed research gaps, in this article the attention was focused on aspects related to the knowledge and attitudes of households towards “green” investments in which they act as investors and as recipients of “green” investments provided by local government units, as well as on the diagnosis of barriers and expectations of households towards the forms of support for “green” investments in Poland.

The research results are intended to contribute to a better understanding of the needs that will enable policy to be adapted to the expectations of households, and thus contribute to a more effective implementation of the energy transformation process in Poland.

### 3. Methods

The research results presented in this article were carried out as part of the ECONomics4ClimateIII project. This project encompasses several research topics in Area 2 closely linked to the goals outlined in the GZM Development Strategy, the Metropolitan Strategic Action Program, and the Regional Innovation Strategy of the Silesian Voivodeship 2030. The goals of this project are also aligned with the UN Sustainable Development Goals, particularly Goal 11 (Sustainable Cities and Communities) and Goal 13 (Climate Action). The research topic under which this article was written is titled: "Household Attitudes Toward Green Investments". The main goal of the research task is to diagnose household attitudes and preferences toward green investments in two fundamental contexts: households acting as investors and as recipients of green investments.

This article formulates three main research objectives. The first is to assess household knowledge and attitudes regarding "green" investments. The second is to identify barriers and expectations regarding forms of support for "green" investments undertaken by households. The final objective involves understanding household attitudes toward "green" investments undertaken by local government units.

A survey questionnaire was designed to conduct the study. This questionnaire consisted of 60 questions, mostly closed-ended and scaled using a Likert scale. Research material was collected using the CAWI method. Representatives of households residing in Poland were selected as the survey respondents. To ensure the study's representativeness, a sample of 1000 households was used. The study was conducted in 2025.

The study was designed to take into account the representativeness of the sample for the GZM Metropolis and Poland, as well as the gender and age of the respondents.

The survey was anonymous. The questionnaire was divided into six sections, including questions regarding:

- values guiding respondents,
- utilitarian issues,

- deontological issues,
- direct variables of the VBN model,
- propensity to invest in "green" infrastructure,
- benefits, knowledge, trust, energy independence, and household behavior as consumers and citizens.

This article presents only selected conclusions from the conducted research.

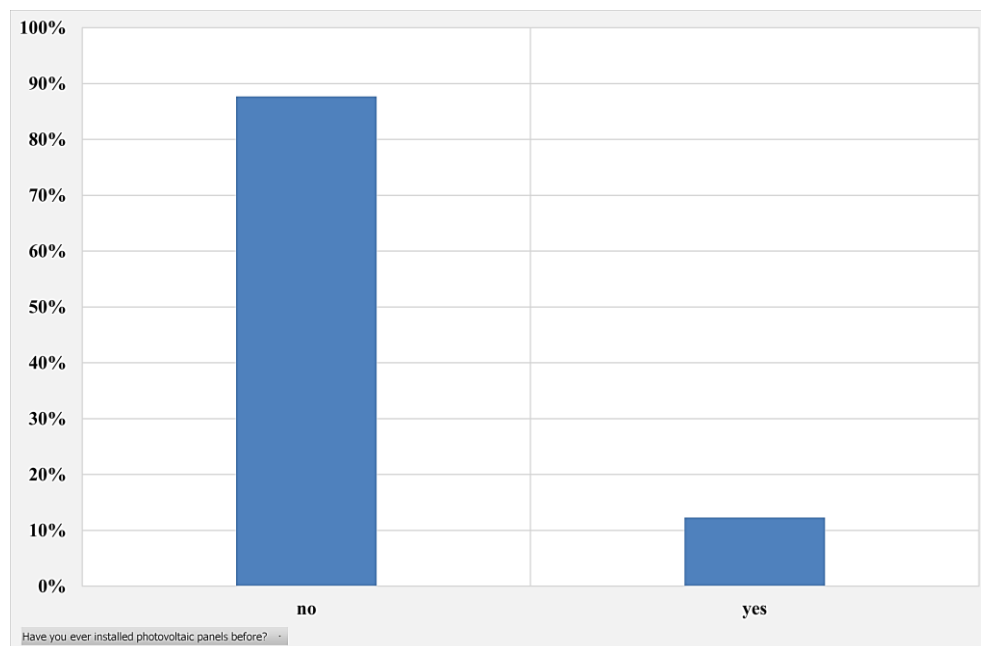
The collection and preparation of the data was financed, among others, by the Metropolitan Fund for the Support of Science.

This article is limited to presenting general results in selected aspects. Future in-depth research is planned based on the collected data, applying Stern's theory of Value-Belief-Norm (VBN). The VBN theory is based on a causal chain explaining the willingness to engage in specific behaviors in the context of environmental issues (Stern et al., 1999).

## 4. Results

The following section presents the research results. The focus is on the first strand of research, which addresses household investors' preferences for one of the components of "green" infrastructure: photovoltaic installations.

The primary goal was to determine whether respondents were investing in photovoltaic installations. The results are presented in Figure 1.

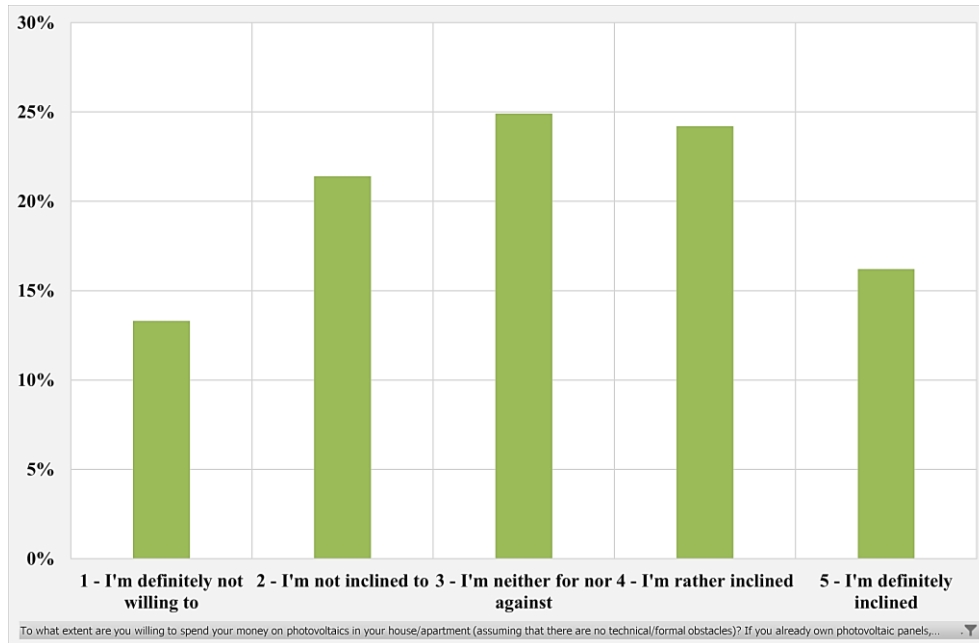


**Figure 1.** Investment activity of households in photovoltaic installations.

Source: Own study.

The survey results indicate that the vast majority of surveyed households have not invested in photovoltaics. Less than 10% of respondents declared that they had installed photovoltaic panels.

The next question asked respondents to what extent they were willing to invest in photovoltaics, and if they already had photovoltaic panels, whether they were willing to invest again, for example, by increasing the surface area or power. Figure 2 presents the results.

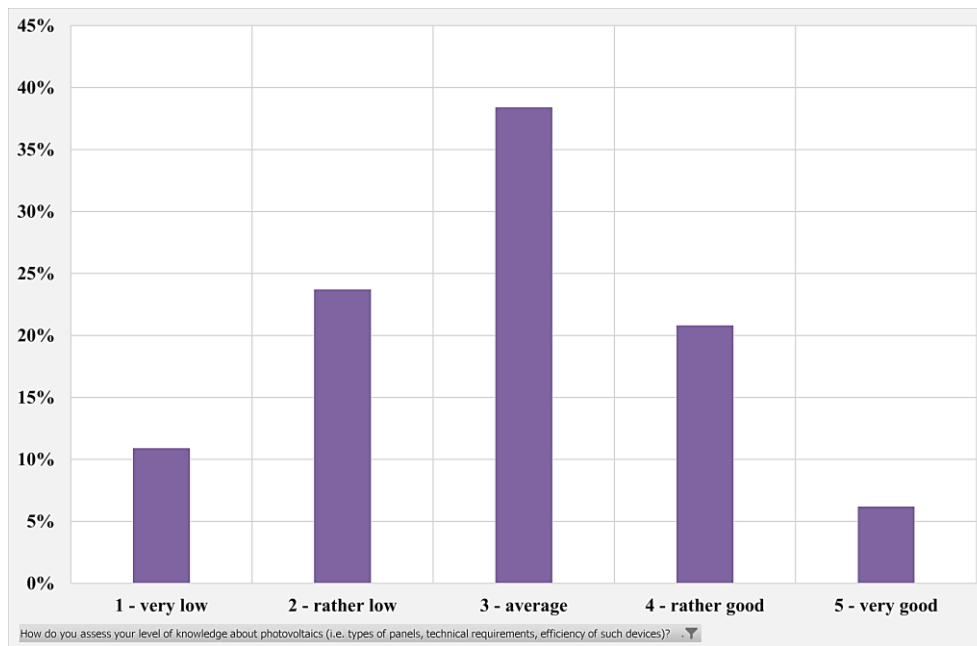


**Figure 2.** Household willingness to invest in photovoltaic panels.

Source: Own study.

The results are mixed. Approximately 40% of respondents are willing to invest in photovoltaics (responses 4 and 5). Conversely, approximately 35% are not willing to make this type of investment (responses 1 and 2).

The next goal of the survey was to determine households' self-assessment of their knowledge regarding the technical aspects of investing in photovoltaics, such as panel types, technical requirements, and installation efficiency. The results are presented in Figure 3.

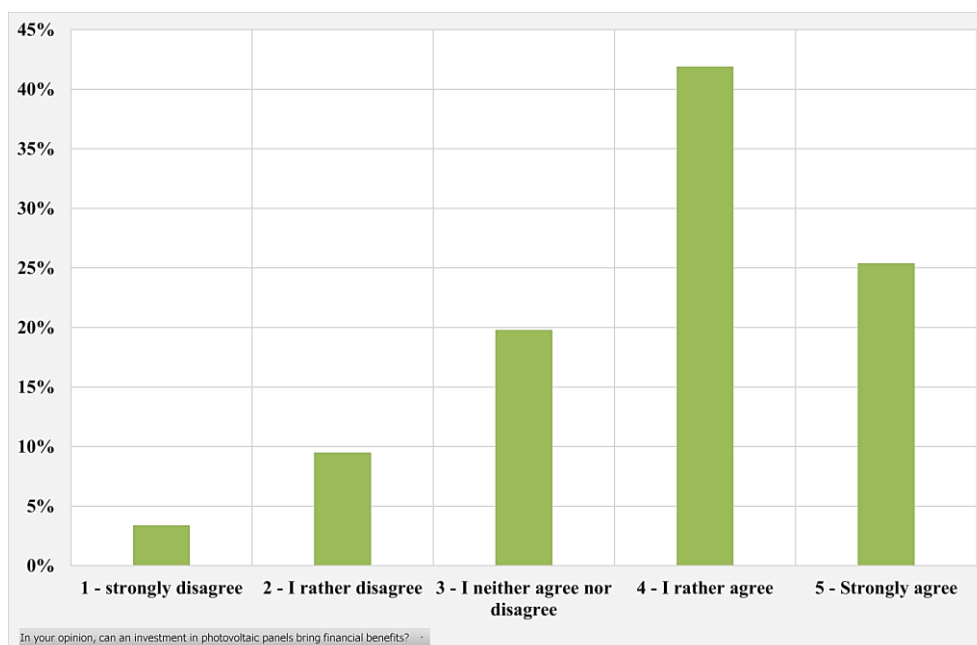


**Figure 3.** Assessment of the level of knowledge of households about the technical aspects of investing in photovoltaics.

Source: Own study.

The research results indicate differences in the level of knowledge regarding the technical aspects of household photovoltaics, however, it can be stated that respondents most often declared having average knowledge (38.4% of respondents), while approximately 27% of respondents stated that they had very good or rather good knowledge in this field.

In turn, household opinions on the financial efficiency of photovoltaic installations are illustrated in Figure 4.

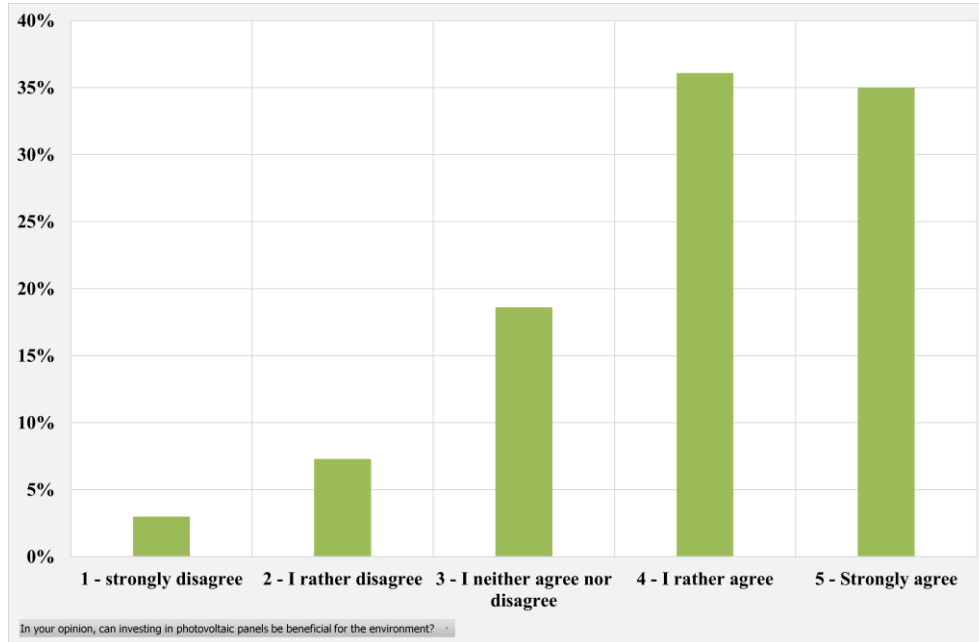


**Figure 4.** Household opinions on the financial effectiveness of investing in photovoltaics.

Source: Own study.

The vast majority of respondents, approximately 67.3% in total (responses 4 and 5), indicated that they consider investing in photovoltaics to be financially efficient.

Respondents were also asked to express their opinion on the environmental benefits of investing in photovoltaics. The responses are presented in Figure 5.

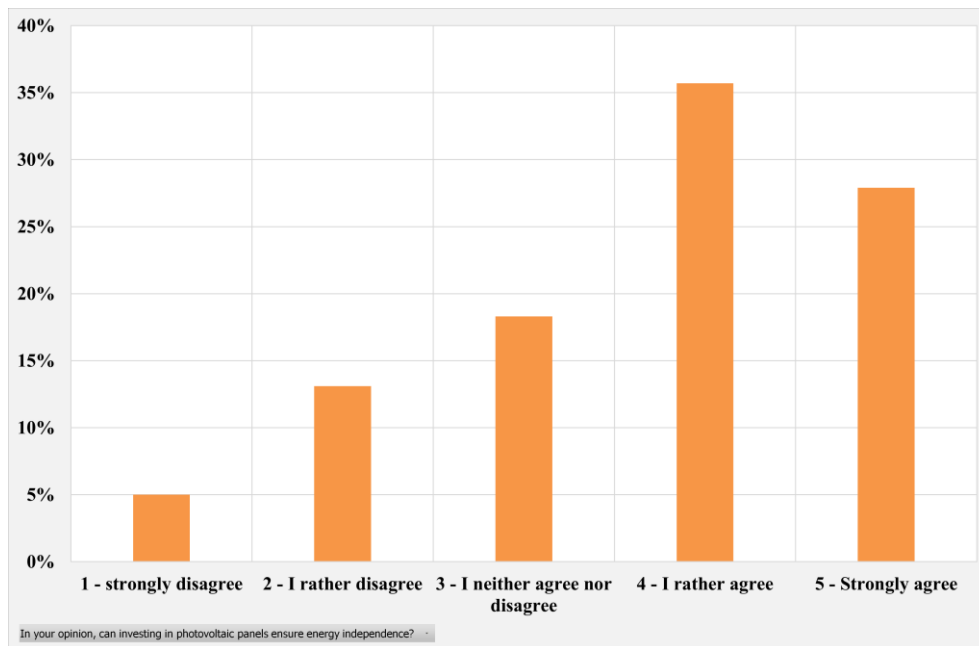


**Figure 5.** Respondents' opinions on the environmental benefits of installing photovoltaic panels.

Source: Own study.

The vast majority of household representatives express the opinion that photovoltaics contributes to generating positive externalities for the natural environment (answers 4 and 5).

The survey also identified respondents' views on the impact of household investments in photovoltaic installations on achieving energy independence. The results are illustrated in Figure 6.

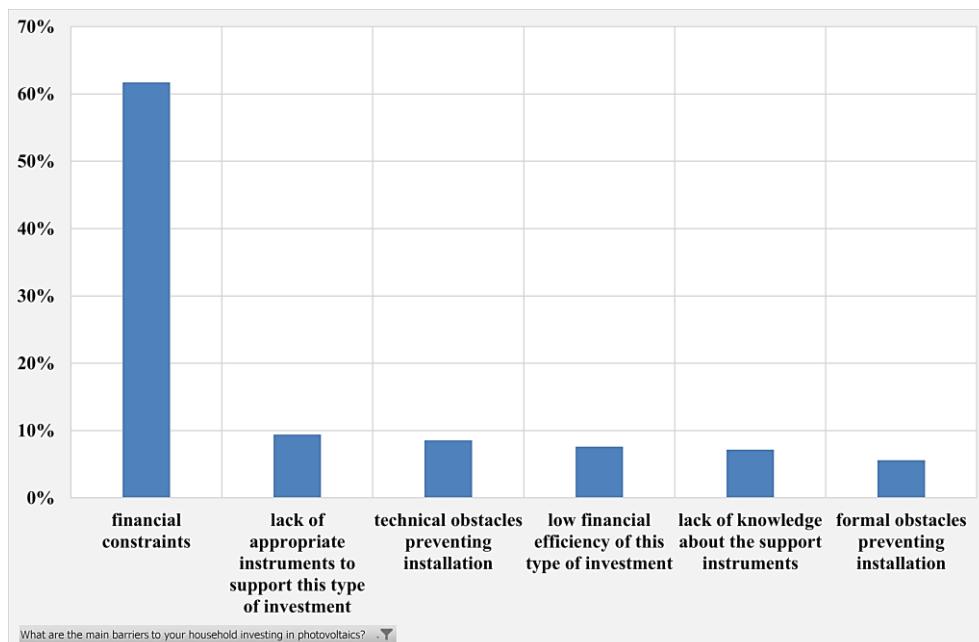


**Figure 6.** Household opinions on the impact of investing in photovoltaic panels on achieving energy independence.

Source: Own study.

The vast majority of respondents – approximately 63.6% – expressed the belief that investing in photovoltaics has a positive impact on achieving energy independence (answers 4 and 5).

The study then aimed to identify the main barriers to household investment in photovoltaics. Figure 7 illustrates the responses.

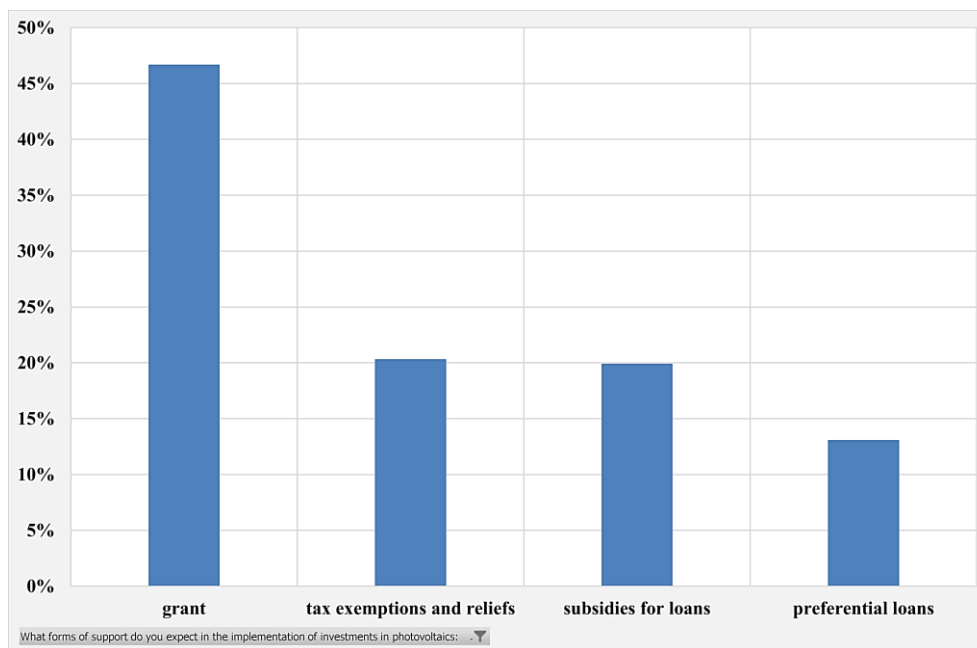


**Figure 7.** Main barriers to household investment in photovoltaic installations.

Source: Own study.

The main obstacle to investing in photovoltaics cited by households is financial barriers (over 60% of respondents). Approximately 10% of respondents indicated a lack of adequate instruments supporting investment in photovoltaics. Approximately 8% of respondents reported a lack of knowledge about existing instruments supporting this type of investment.

The aim of the study was to determine household expectations regarding the forms of support for investing in photovoltaic installations. These expectations are presented in Figure 8.

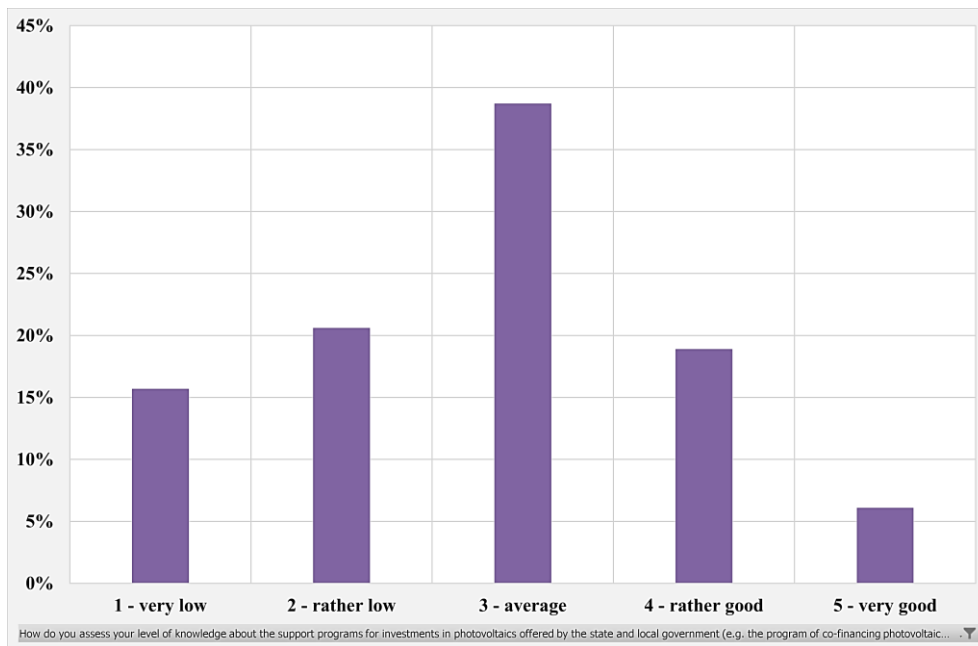


**Figure 8.** Household expectations regarding forms of support for investments in photovoltaic panels.

Source: Own study.

The most desirable form of support for household investments in photovoltaic panels is grants. This was the response of nearly half of the survey respondents.

The study further aimed to determine how households assess their level of knowledge about programs supporting photovoltaic investments offered by the state and local governments. Figure 9 presents the results.

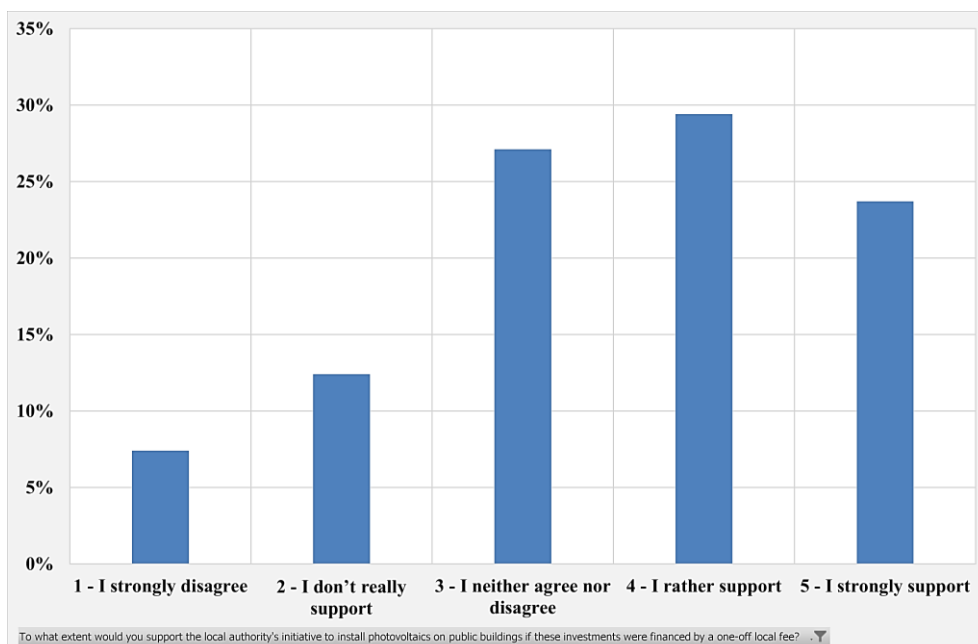


**Figure 9.** Household knowledge about programs supporting investments in photovoltaic panels.

Source: Own study.

As the survey results indicate, households' knowledge of photovoltaic investment support programs varies. Over 35% of respondents considered their knowledge on this topic to be very low or rather low.

The second research strand aimed to understand the preferences of households participating in photovoltaic investments made by local government units. Figure 10 presents the results regarding households' level of support for local government investments in photovoltaic installations.

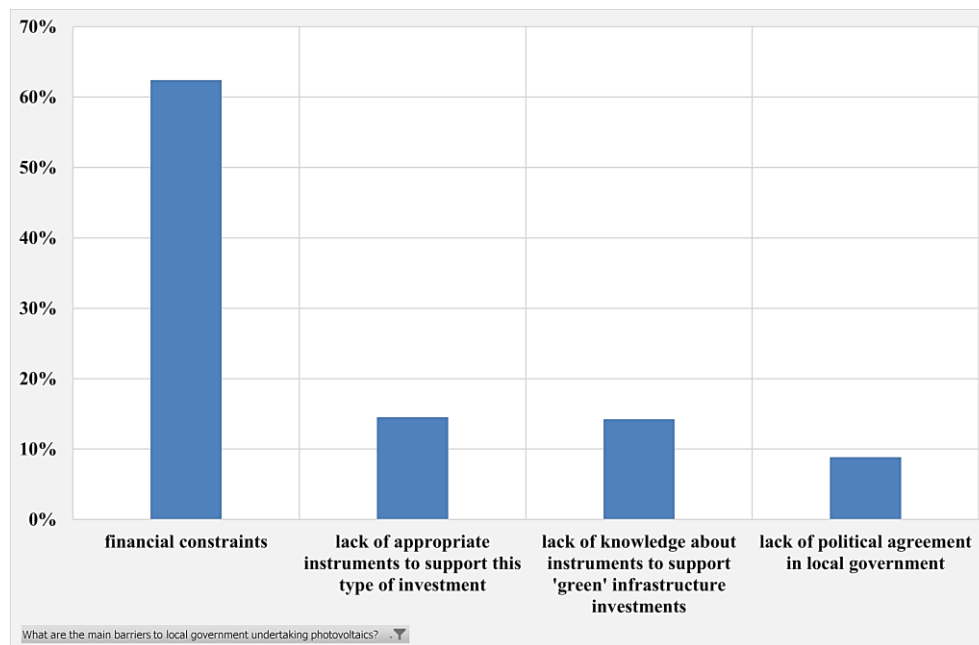


**Figure 10.** Degree of support for local government investments in photovoltaics by households.

Source: Own study.

According to the survey, over half of respondents support local government investment in photovoltaics (responses 4 and 5), while approximately 20% do not support this type of initiative (responses 1 and 2).

Respondents were asked about their opinions on the main barriers preventing local governments from investing in photovoltaics. Figure 11 presents the responses.



**Figure 11.** Main barriers to investing in photovoltaic installations by local government units in the opinion of households.

Source: Own study.

The results indicate that, in the opinion of respondents, the main barrier to investing in photovoltaics by local government units is financial constraints. Households expressed the same opinion regarding the barriers to investing in photovoltaic panels by households, as shown in Figure 7.

## 5. Discussion

In the first area, nationwide research enabled a diagnosis of household attitudes and knowledge regarding one of the components of "green" investments, namely photovoltaic installations. It was found that the vast majority of households had not invested in photovoltaics (approximately 90%) – as of 2025. Considering the literature on the subject, these results complement the current state of knowledge. These aspects were the subject of research by, among others, Igliński et al. (Igliński et al., 2022), who examined the situation of the photovoltaic sector in Poland and globally, although these studies addressed all types of prosumers. Rataj et al., in turn, indicate that Poland is a leader in the growth dynamics of the

photovoltaic market (Rataj et al., 2021). The results of our own research indicate significant potential for the photovoltaic market in Poland and the potential for greater household involvement in energy production, and thus greater involvement in the country's energy transformation process. The study aimed to provide insight into households' willingness to invest (including reinvestment) in photovoltaics nationwide. The results indicate a scattering of respondents' responses, with approximately 40% of households declaring a willingness to undertake this type of investment. Stanisławska conducted research in this area, limiting the scope of her research to owners of single-family homes located in the Lower Silesian Voivodeship (Stanisławska, 2023). Both studies indicate that the willingness to invest is limited and constrained by various barriers. Foreign studies also point to differences in the willingness to invest in photovoltaics and varying degrees of acceptance for this type of investment (Gava Gastaldo, et al., 2019).

The nationwide survey also aimed to address household knowledge of selected aspects of investing in photovoltaics, including technical aspects, financial efficiency, environmental benefits, and the impact of this type of investment on achieving energy independence. Filling the identified research gap in these areas may allow for a better understanding of the investor profile and the adaptation of national-level actions aimed at increasing household involvement in the energy transition. These issues are addressed in the international literature by Gava Gastaldo et al. (Gava Gastaldo et al., 2019). The issue of knowledge and availability of information about photovoltaics was also the subject of research by Sommerfeldt et al. in Sweden (Sommerfeldt et al., 2022). In Poland, research is limited to identifying the factors determining investment in photovoltaics (Wicki et al., 2022; Błaszczuk, 2024). The results of the conducted research indicate knowledge deficits regarding the technical aspects of investing in photovoltaics. In this regard, it is necessary to advocate for informational activities. The vast majority of surveyed households declare knowledge about the financial efficiency of photovoltaic panels, their environmental benefits, and their impact on achieving energy independence.

Another area of research identified the main barriers to household investment in photovoltaics. Financial constraints were identified as the primary barrier to investment in Poland. In other areas, households reported that these barriers included the lack of adequate instruments supporting investment in photovoltaics and a lack of knowledge in this area. Other comparative studies conducted in Poland and Finland point to inflexible, ineffective, and excessive regulatory frameworks, limited financing options, and insufficient public awareness as the main barriers hindering the widespread adoption of this type of investment (Juszczak et al., 2022). Similar comparative studies were conducted by Wardal et al. in Germany, Italy, Spain, and Poland, where they identified many specific barriers in addition to economic ones (Wardal et al., 2024). A new finding in the results of own research was that households primarily perceive financial constraints as the main barrier. This issue should be taken into account in shaping support for photovoltaic investments.

The study also aimed to determine household expectations regarding forms of support for investments in photovoltaic installations. The study results indicate that subsidies are the most desirable form of support. In other respects, households expect tax exemptions and loan subsidies. Research conducted by Stanisławska (Stanisławska, 2023) indicates certain similarities in the expected forms of support, demonstrating the need to develop more effective support mechanisms, including those related to financial accessibility and the perceived profitability of photovoltaic investments. As the author of the study states, policy interventions should take these factors into account to support the implementation of green energy, especially in low-income households. A limitation of the cited research results is that they were conducted for a sample of single-family homeowners in the Lower Silesian Voivodeship. The special role of tools in shaping economic conditions, particularly investor subsidies, is demonstrated by research conducted in the Visegrad Group countries (Kułyk et al., 2023). It's worth mentioning that our own research also provided insight into household knowledge of programs supporting investments in photovoltaic panels. A new finding from the study is that over 35% of respondents have a low level of knowledge on this topic. This situation requires action to promote awareness of forms of support for "green" investments. Considering this observation leads to the conclusion that, in addition to the identified need to adapt financial support for photovoltaic investments, there is also a need to improve communication regarding existing instruments supporting "green" household investments.

The final area of research focused on household support for photovoltaic investments undertaken by local government units. The study's findings filled a previously identified research gap related to understanding the level of support for this type of investment and the barriers to investment by local government units. A new finding from the study is that the majority of households support this type of investment, citing financial constraints as the main barrier to investment. Therefore, it is recommended that action be taken at the government level to improve the policy framework for energy transition in local government units.

## Summary

Implementing the climate transition requires numerous actions at the European Union and Member State levels. For Poland, this process represents one of its greatest contemporary challenges, particularly given the current conditions and the economy's reliance on conventional energy sources. This issue is the subject of numerous scientific studies and reports. Implementing the EU's climate policy objectives by 2050 requires numerous investment projects in renewable energy sources, including photovoltaic installations. It is becoming essential to engage both public sector entities and the private sector, including households, in financing photovoltaic installations. In this context, it is important to learn about the knowledge

and preferences of households acting as investors and recipients of “green” investments, as well as to diagnose the barriers and expectations of households in order to develop appropriate institutional solutions to support initiatives in the field of investment in photovoltaic panels.

This paper presents selected results from a nationwide study conducted in 2025. A key limitation of the study was its reliance on household respondents. The research findings presented in this article constitute a preliminary exploration of the problem. Future implementation of the VBN model is planned. The results of this study provide information that can be used to develop new institutions supporting photovoltaic investments, and also contribute to filling a identified research gap.

The research results indicate, firstly, that household investment activity in photovoltaic installations remains relatively low, therefore, it is necessary to create new instruments to promote this type of investment project. In this context, it is worth emphasizing that the conducted research provides new knowledge on the relatively high level of household willingness to invest in photovoltaics, as well as positive opinions regarding the financial effectiveness of investing in photovoltaics and their positive impact on achieving energy independence. A diagnosis of household attitudes toward investing in photovoltaics supports the need to implement new systemic solutions to support households' involvement in the energy transition process. The results indicate a lack of knowledge among Polish households regarding the technical aspects of investing in photovoltaics and programs supporting such investments. In this regard, the research indicates the need for informational activities and improved communication, which could contribute to increased interest in such investments.

The research also showed that the main barrier to investing in photovoltaic installations by households is financial, which is why it is necessary to review the policy regarding the forms of support for this type of investment projects.

The research indicates that households consider subsidies to be the most desirable form of support for photovoltaic investments. The study indicates that households primarily expect the creation of instruments that influence the financial efficiency of this type of investment. Therefore, it is necessary to propose a review of existing financial support instruments to stimulate household investment activity, and these actions should be accompanied by parallel efforts to disseminate information about investment support programs. The research findings can support the development of new investment support instruments to meet the identified needs of households while simultaneously highlighting identified communication issues.

Households acting as recipients (users) of investments in photovoltaic installations provided by local government units express a positive opinion on the merits of such investments and simultaneously indicate that, in their opinion, the main barrier to implementing such investment projects by local government units is financial constraints. In this regard, the conducted research leads to the conclusion that it is also becoming necessary for local government units to develop financial support instruments for photovoltaic investments.

In summary, the results of this study provide valuable insights for researchers studying energy transition and the economics of climate change, as well as practical managerial and regulatory implications for addressing the challenges associated with the energy transition process.

Future research should apply the VBN model to further refine the findings. Furthermore, research should explore the causes of perceived insufficient financial support and determine the roles of various forms of support. Furthermore, research with a subjective perspective should be extended to include enterprises in the future.

## References

1. Assereto, M., Byrne, J. (2020). The Implications of Policy Uncertainty on Solar Photovoltaic Investment. *Energies*, 13(23), 6233, <https://doi.org/10.3390/en13236233>
2. Błaszczuk, A., Matuszak-Flejszman, A., Nawrocki, K. (2024). Determinants of the development of photovoltaics in Poland. *Renewable Energy*, 233, 121161, <https://doi.org/10.1016/j.renene.2024.121161>
3. Bragolusi, P., D'Alpaos, C. (2021). The Willingness to Pay for Residential PV Plants in Italy: A Discrete Choice Experiment. *Sustainability*, 13(19), 10544, <https://doi.org/10.3390/su131910544>
4. Communication from the Commission to the European Parliament, The European Council, The Council, The European Economic and Social Committee and the Committee of the Regions. The European Green Deal. (2019). European Commission, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52019DC0640>
5. Dąbrowska, A., Maciejczak, M., Ozimek, I. (2024). Determinants of the investments in photovoltaic micro-installations by individual users in Poland. *Acta Scientiarum Polonorum. Oeconomia*, 22(2), pp. 31-50, <https://doi.org/10.22630/ASPE.2023.22.2.10>
6. Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652
7. Energy 2024 (2024). Central Statistical Office (CSO), <https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/energia-2024,1,12.html>
8. Engel, W.H., Purta, M., Speelman, E. (2020). *Carbon Neutral Poland 2050: How to Turn a Challenge into an Opportunity*. McKinsey&Company
9. Gava Gastaldo, N., Rediske, G., Donaduzzi Rigo, P., Brum Rosa, C., Michels, L., Mairesse Siluk, J.C. (2019). What is the Profile of the Investor in Household Solar Photovoltaic Energy Systems? *Energies*, 12(23), 4451, <https://doi.org/10.3390/en12234451>

10. Grębosz-Krawczyk, M., Zakrzewska-Bielawska, A., Glinka, B., Glińska-Noweś, A. (2021). Why Do Consumers Choose Photovoltaic Panels? Identification of the Factors Influencing Consumers' Choice Behavior regarding Photovoltaic Panel Installations. *Energies*, 14(9), 2674, <https://doi.org/10.3390/en14092674>
11. Huo, M.L., Zhang, D.W. (2012). Lessons from photovoltaic policies in China for future development. *Energy Policy*, 51, pp. 38-45, <https://doi.org/10.1016/j.enpol.2011.12.063>
12. Igliński, B., Piechota, G., Kielkowska, U. (2023). The assessment of solar photovoltaic in Poland: the photovoltaics potential, perspectives and development. *Clean Technologies and Environmental Policy*, 25, pp. 281-298. <https://doi.org/10.1007/s10098-022-02403-0>
13. Juszczak, O., Juszczak, J., Juszczak, S., Takala, J. (2022). Barriers for Renewable Energy Technologies Diffusion: Empirical Evidence from Finland and Poland. *Energies*, 15(2), 527, <https://doi.org/10.3390/en15020527>
14. *Krajowy Plan w Dziedzinie Energii i Klimatu na lata 2021-2030* (2019). Ministry of State Assets, <https://www.gov.pl/web/klimat/krajowy-plan-na-rzecz-energii-i-klimatu-na-lata-2021-2030---wersja-2019-r>
15. Kułyk, P., Michałowska, M., Szudra, P. (2023). Assessment of the conditions for the development of the photovoltaic investment in the countries of the Visegrad Group – Comparative study of the researched countries. *Energy Reports*, 10, pp. 3929-3940, <https://doi.org/10.1016/j.egy.2023.10.042>
16. Kundzewicz, Z.W., Matczak, P. (2012). Climate change regional review: Poland. *WIREs Climate Change*, 3(4), pp. 297-311, <https://doi.org/10.1002/wcc.175>
17. Lee, M.-K., Kim, J.-H., Yoo, S.-H. (2018). Public Willingness to Pay for Increasing Photovoltaic Power Generation: The Case of Korea. *Sustainability*, 10(4), 1196, <https://doi.org/10.3390/su10041196>
18. Mauleón, I. (2017). Photovoltaic investment roadmaps and sustainable development. *Journal of Cleaner Production*, 167, <https://doi.org/10.1016/J.JCLEPRO.2017.08.148>
19. Moosavian, S.M., Rahim, N.A., Selvaraj, J., Solangi, K.H. (2013). Energy policy to promote photovoltaic generation. *Renewable and Sustainable Energy Reviews*, 25, pp. 44-58, <https://doi.org/10.1016/j.rser.2013.03.030>
20. Mrozowska, S., Wendt, J.A., Tomaszewski, K. (2021). The Challenges of Poland's Energy Transition. *Energies*, 14(23), <https://doi.org/10.3390/en14238165>
21. Mularczyk, A., Zdonek, I., Turek, M., Tokarski, S. (2022). Intentions to Use Prosumer Photovoltaic Technology in Poland. *Energies*, 15(17), 6300, <https://doi.org/10.3390/en15176300>
22. Opracowanie Strategii Rozwoju Górnośląsko-Zagłębiowskiej Metropolii na lata 2022-2027, z perspektywą do 2035 r. (2022). Zeszyt nr 2, Diagnoza Stanu GZM.
23. Palm, J. (2018). Household installation of solar panels – Motives and barriers in a 10-year perspective. *Energy Policy*, 113, pp. 1-8, <https://doi.org/10.1016/j.enpol.2017.10.047>

24. Petrovich, B. (2021). *Determinants of households' decisions to invest in residential solar photovoltaic systems and implications for policy*. <https://www.alexandria.unisg.ch/entities/publication/6861d68b-f503-4e1c-990a-3654f87fa554>
25. *Polityka energetyczna Polski do roku 2040* (2021). Ministry of Climate and Environment. <https://www.gov.pl/web/ia/polityka-energetyczna-polski-do-2040-r-pep2040>
26. Projekt Krajowego Planu w dziedzinie Energii i Klimatu do 2030 r. – wersja wstępna z 02.2024 r. (2024). Ministry of Climate and Environment. <https://www.gov.pl/web/klimat/projekt-krajowego-planu-w-dziedzinie-energii-i-klimatu-do-2030-r--wersja-wstepna-z-022024-r>
27. Projekt Krajowego Planu w dziedzinie Energii i Klimatu do 2030 r. – wersja do konsultacji publicznych z 10.2024 r. wraz z prognozą oddziaływania na środowisko z 02.2025 r. (2024). Ministry of Climate and Environment. <https://www.gov.pl/web/klimat/projekt-krajowego-planu-w-dziedzinie-energii-i-klimatu-do-2030-r--wersja-do-konsultacji-publicznych-z-102024-r>
28. Rataj, M., Berniak-Woźny, J., Plebańska, M. (2021). Poland as the EU Leader in Terms of Photovoltaic Market Growth Dynamics-Behind the Scenes. *Energies*, 14(21), 6987, <https://doi.org/10.3390/en14216987>
29. Regionalna Strategia Innowacji Województwa Śląskiego 2030. Uchwała Zarządu Województwa Śląskiego Nr 1554/246/VI/2021 z dnia 30 czerwca 2021 r. (2021). <https://ris.slaskie.pl/pl/dokumenty/regionalna-strategia-innowacji-wojewodztwa-slaskiego-2030.html>
30. Regulation (EU) 2021/1119 of the European Parliament and the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'), <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1119>
31. Skordoulis, M., Ntanos, S., Arabatzis, G. (2020). Socioeconomic evaluation of green energy investments: Analyzing citizens' willingness to invest in photovoltaics in Greece. *International Journal of Energy Sector Management*, 14(5), pp. 871-890, <https://doi.org/10.1108/IJESM-12-2019-0015>
32. Sommerfeldt, N., Lemoine, I., Madani, H. (2022). Hide and seek: The supply and demand of information for household solar photovoltaic investment. *Energy Policy*, 161, 112726, <https://doi.org/10.1016/j.enpol.2021.112726>
33. Stanisławska, M. (2023). An Examination of Households' Attitudes towards Renewable Energy Source Investments in Lower Silesian Voivodeship. *Energies*, 16(20), 7100, <https://doi.org/10.3390/en16207100>
34. Stern, P.C., Dietz, T., Abel, T., Guagnano, G.A., Kalof, L. (1999). A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism. *Human Ecology Review*, 6(2), pp. 81-97.

35. Strategia Rozwoju Górnośląsko-Zagłębiowskiej Metropolii na lata 2022-2027 z perspektywą do 2035 r. Uchwała Zgromadzenia Górnośląsko-Zagłębiowskiej Metropolii nr XLIX/367/2022 z dnia 16 grudnia 2022 r. (2022), <https://bip.metropoliagzm.pl/artykul/34552/129693/strategia-rozwoju-gornoslasko-zaglebiowskiej-metropolii-na-lata-20222027-z-perspektywa-do-2035-r>
36. Strategia Rozwoju Województwa Śląskiego „Śląskie 2030”. Uchwała Sejmiku Województwa Śląskiego nr VI/24/1/2020 z dnia 19 października 2020 r. (2020). [https://bip.slaskie.pl/sejmik\\_wojewodztwa/sesje\\_sejmiku/uchwaly/uchwala-sejmiku-nr-vi-24-1-2020-z-dnia-2020-10-19.html](https://bip.slaskie.pl/sejmik_wojewodztwa/sesje_sejmiku/uchwaly/uchwala-sejmiku-nr-vi-24-1-2020-z-dnia-2020-10-19.html)
37. Sun, P.-C., Wang, H.-M., Huang, H.-L., Ho, C.-W. (2018). Consumer attitude and purchase intention toward rooftop photovoltaic installation: The roles of personal trait, psychological benefit, and government incentives. *Energy & Environment*, 31(1), pp. 21-39, <https://doi.org/10.1177/0958305X17754278>
38. Tatarewicz, I., Lewarski, M., Skwierz, S. (2022). *Poland net-zero 2025*. CAKE in KOBIZE, IOŚ-PIB.
39. Ugulu, A.I., Aigbavboa, C. (2019). Assessing Urban Households' Willingness to Pay for Standalone Solar Photovoltaic Systems: A Case Study of Lagos. *Nigeria Journal of Sustainable Development of Energy, Water and Environment Systems*, 7(3).
40. Wardal, W.J., Mazur, K., Barwicki, J., Tseyko, M. (2024). Fundamental Barriers to Green Energy Production in Selected EU Countries. *Energies*, 17(15), 3664, <https://doi.org/10.3390/en17153664>
41. Wicki, L., Pietrzykowski, R., Kusz, D. (2022). Factors Determining the Development of Prosumer Photovoltaic Installations in Poland. *Energies*, 15(16), 5897, <https://doi.org/10.3390/en15165897>
42. Zeru A.M., Guta, D.D. (2021). Factors influencing rural household attitude towards solar home system in Ethiopia. *Renewable Energy and Environmental Sustainability*, 6(42), <https://doi.org/10.1051/rees/2021048>
43. Zhang, R., Lee, M., Huang, L., Mei, S. (2025). Household attitudes and characteristics towards photovoltaic adoption in Hong Kong: Identifying the determinants for sustainable energy transition. *Energy and Buildings*, 330, 115347, <https://doi.org/10.1016/j.enbuild.2025.115347>