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ORIGINAL PAPER

THE SUBSIDY SYSTEM AS A PREREQUISITE FOR THE DEVELOPMENT OF MICRO-PHOTOVOLTAIC INSTALLATIONS IN HOUSEHOLDS IN POLAND

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JEL Classification: Q01, Q2, Q4.

Key words: payback period, renewable energy sources, profitability, government programmes.

Abstract

The aim of the study was to assess the profitability of investing in a micro photovoltaic installation in a household that benefited from funding under the government's "My Electricity" programme. Methods for assessing the profitability of investment projects were used. The net present value (NPV) and the payback period (DPP) were calculated. The payback period is longer than that declared in the agreement between the investor and the company responsible for the installation and calculation of the profitability of the photovoltaic panels. The subsidy received under the government's "My Electricity" programme significantly shortened the payback period. The payback period declared in the agreement between the investor and the company involved in the installation and calculation of the profitability of photovoltaic panels is underestimated. Companies involved in the installation and calculation of the profitability of photovoltaic panels reduce the payback period for investors' expenditure on the installation of photovoltaic panels. Government support programmes may contribute to an increase in interest in investments in renewable energy sources (RES) among households.

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SYSTEM DOTACJI JAKO WARUNEK ROZWOJU MIKROINSTALACJI FOTOWOLTAICZNYCH W GOSPODARSTWACH DOMOWYCH W POLSCE

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Słowa kluczowe: okres zwrotu, odnawialne źródła energii, opłacalność, programy rządowe.

Abstrakt

Celem badań była ocena opłacalności inwestycji w mikroinstalację fotowoltaiczną w gospodarstwie domowym, w którym skorzystano z dofinansowania w ramach rządowego programu „Mój Prąd". Posłużono się metodami oceny opłacalności projektów inwestycyjnych. Obliczono wartość zaktualizowaną netto (ang. NPV) oraz okres zwrotu poniesionych nakładów (ang. DPP). Okres zwrotu nakładów inwestycyjnych jest dłuższy niż ten zadeklarowany w umowie zawartej między inwestorem, a firmą zajmującą się montażem i kalkulacją opłacalności paneli fotowoltaicznych. Otrzymane w ramach rządowego programu „Mój prąd" dofinansowanie w znaczącym stopniu skróciło okres zwrotu nakładów inwestycyjnych. Okres zwrotu zadeklarowany w umowie zawartej między inwestorem, a firmą zajmującą się montażem i kalkulacją opłacalności paneli fotowoltaicznych jest zaniżony. Firmy zajmujące się montażem i kalkulacją opłacalności paneli fotowoltaicznych zaniżają okres zwrotu nakładów ponoszonych przez inwestorów na instalacje paneli fotowoltaicznych. Rządowe programy wsparcia przyczynić się mogą do wzrostu zainteresowania inwestycjami w odnawialne źródła energii (ang. RES) wśród gospodarstw domowych.

Introduction

Energy independence is an important element in ensuring the security of every country, including Poland. The European Union combines this goal with measures to combat climate change. Therefore, increasing the share of renewable energy sources in the energy mix has become a priority. At the same time, intensive efforts are being made to decarbonise economies, which means a gradual shift away from coal as the main source of carbon dioxide emissions. These emissions have a negative impact on the atmosphere and contribute to the exacerbation of global warming, posing serious threats to the environment and societies. As part of its fight against the climate crisis, the EU is implementing initiatives such as the European Green Deal. In the face of the war in Ukraine, it has become necessary to change the approach to energy policy, renewable energy sources and the discussion on global warming, adapting them to new challenges and geopolitical conditions (Sikora & Zimniewicz, 2023, p. 457).

The aim of the study was to assess the profitability of investing in a micro-photovoltaic installation in a household that benefited from funding under the government's "My Electricity" programme.

The following research hypothesis was put forward: the investment costs incurred by the household to implement the photovoltaic investment, after taking into account the subsidy obtained, will pay for themselves within the period specified in the agreement between the investor and the company responsible for the installation and calculation of the profitability of the photovoltaic panels.

The article describes the most important conditions for the development of photovoltaics in Poland and the available government programmes supporting the profitability of photovoltaic micro-installations among households. The subject of the study was a household located in the Warmian-Masurian Province equipped with a photovoltaic installation mounted on the roof of a residential building. Using this example, an attempt was made to demonstrate the rationality of investing in renewable energy sources by households.

Geographical and political conditions for the development of photovoltaics in Poland

Solar energy is one of the most environmentally friendly renewable energy sources. It is characterised by almost unlimited resources, wide availability and the possibility of direct conversion into other forms of energy, e.g. through photovoltaic, chemical or photochemical conversion. However, its main limitations include cyclical fluctuations in availability (daily and seasonal), dispersion of energy at different times of the year, dependence on the angle of sunlight and the influence of weather conditions. In addition, the high cost of the equipment necessary to convert this energy poses a significant challenge. It is worth noting, however, that the costs of manufacturing and installing photovoltaic panels are steadily decreasing as a result of technological advances and falling component prices. This is making solar energy increasingly accessible and economically viable (Grzebyk & Stec, 2023, p. 247).

The response to these growing threats is the European Green Deal, whose actions and initiatives are developed by the European Commission, with the main goal of achieving climate neutrality by the European Union member states. This policy is a response to the growing threats associated with climate change, which is leading to global warming and could cause an ecological disaster in the future. The new approach to climate policy aims to prevent these negative effects. The basic principles of the European Green Deal were presented in a communication from the European Commission dated 11 December 2019, addressed to the European Parliament, the European Council, the Economic and Social Committee and the Committee of the Regions. This document, entitled

“The European Green Deal”, presents a general policy framework that will be developed in subsequent legal regulations, such as directives and regulations. The European Green Deal is an ambitious action plan aimed at transforming the EU economy in a sustainable and environmentally friendly manner (Świdyńska, 2024, p. 33).

Energy efficiency is one of the strategic priorities of the European Green Deal. In the context of the European Union, the energy intensity of a country’s economy can be determined on the basis of the ratio of primary and final energy consumption to the level of economic production, measured by GDP. According to current estimates, the energy intensity of the Polish economy is almost twice as high as the EU average. However, it is worth noting that significant progress has been made in this area over the last 20 years. The Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources has been in force in the European Union for over 15 years. By 2020, it was assumed that 20% of total final energy consumption in the EU should come from RES, with different percentage targets set for individual Member States. These targets were set in such a way as to enable them to be achieved, while motivating Member States to intensify their efforts to increase the share of renewable energy. In 2020, the average share of RES in final energy consumption in EU countries was 22%. Of the 27 Member States, as many as 23 exceeded their targets. The only exception was France, which failed to achieve its target of a 23% share of RES in final energy consumption (Szczubełek, 2022, p. 182).

The main challenges limiting the development of photovoltaics stem from technological issues related to energy efficiency, as well as aspects concerning safety, economics and legal regulations. Research largely focuses on optimising and improving the energy efficiency of these installations and on improving the country’s energy security. In economic and legal terms, there are differences between Poland and other countries in terms of energy prices, availability of subsidies, building permit requirements and changing legal regulations. Subsidy programmes in Poland aimed at the development of renewable energy sources are an attractive incentive for investors, motivating them to invest in such installations. Micro-installations (with a capacity of up to 50 KWP) face relatively few legal barriers – no building permit is required for their construction , and energy settlements can be made under programmes such as Prosument, both for households and businesses (Olczak *et al.*, 2020, p. 124).

The use of RES is an important part of global efforts to find new, more environmentally friendly energy sources and diversify existing sources of energy production. The global increase in energy demand, combined with growing awareness of the negative effects of fossil fuel use and their limited resources, is contributing significantly to the growing interest in RES. Furthermore, the prospect of energy resources running out makes the need to find alternative energy sources increasingly important.

In this context, among the various RES available, solar energy is gaining importance as one of the most promising solutions. Unlike fossil fuels, this energy is available in unlimited quantities and can be an important element in the energy transition process aimed at meeting the growing demand for energy while reducing the impact on the environment (Sala, 2018, p. 132).

Government programmes supporting the profitability of micro photovoltaic installations

According to Mielczarski (2021, p. 85), the development of renewable energy sources in Poland depends to a large extent on support in the form of subsidy schemes. Between 2005 and 2015, a green certificate mechanism was in place. Under this system, renewable energy producers fed their energy into the power grid, selling it on the market or to companies obliged to purchase it. They also received green certificates, which were a financial support instrument. Energy distributors were obliged to purchase certificates in proportion to their turnover. At that time, RES energy prices were 2–2.5 times higher than market prices, which encouraged rapid growth in investment in this sector, but also placed a burden on energy consumers. The costs of subsidies under this system exceeded PLN 5 billion per year. In 2015, Poland introduced a new auction-based support system, where producers can obtain 15-year contracts to sell energy at fixed reference prices. These prices, although higher than market prices, are rising in line with the European Union's ambitious climate targets. It is forecast that the average annual support for renewable energy sources in Poland in the coming years will amount to between PLN 8 and 10 billion. However, the costs associated with renewable energy sources include not only direct subsidies, but also the need to maintain power reserves to ensure stability of supply, especially during periods of low renewable energy production (e.g. when there is no wind or sun). Currently, these reserves are provided by coal, gas and nuclear power plants, which are essential for energy security. Declining energy production in these power plants, caused by the increase in the share of RES, requires additional forms of support. In response, a capacity market, a system of subsidising conventional reserve capacity, was introduced in Poland in 2019. The costs of this mechanism amount to over PLN 5.5 billion per year, and contracts under the capacity market will remain in force until the early 2040s. Thus, the capacity market acts as indirect support for the development of RES, compensating conventional power plants for the decline in revenue resulting from the reduction in their production (Mielczarski, 2021, p. 85).

Polish support programmes for RES are an incentive for investors, enabling the implementation of a variety of projects. The scale of funding depends on the size of the installation and the nature of the investment. The available forms of support include, among others, feed-in tariffs, subsidies and auctions. Micro-installations with a capacity of up to 50 kWp benefit from simplified legal procedures – they do not require a building permit, and the Prosument programme allows both households and businesses to use the settlement system. Under the project, installations with a capacity of up to 10 kWp can be built, allowing energy to be fed into the grid with the possibility of later using up to 80% of this energy over a one-year period. In addition, both small and larger installations can benefit from Regional Operational Programmes financed by the European Regional Development Fund. In the case of households, co-financing is provided through local governments, such as municipalities, which take measures to increase the share of renewable energy in the region. However, the effectiveness of obtaining funds depends on the commitment and efficiency of these entities (Olczak *et al.*, 2020, p. 124).

The thermal modernisation relief is a form of tax support for people who carry out modernisation work aimed at reducing a building's energy demand. Although it is most often associated with activities such as wall insulation or the replacement of outdated heating systems, photovoltaic installations are also eligible for this type of relief. The thermal modernisation relief can be combined with other forms of support, such as subsidies, which further reduces the cost of the investment. This relief is available to owners or co-owners of single-family residential buildings that have been put into use (this does not apply to buildings under construction). The owner can take advantage of the relief even if they do not live in the property themselves (Fotowoltaikaonline.pl, 2024).

The "My Electricity" programme is an important stimulus for the development of prosumer energy in Poland, as can be seen from the growing number of photovoltaic micro-installations in recent years. The programme was implemented in two editions in 2019 and 2020. It offered direct subsidies to households for photovoltaic installations. The total allocation of funds for co-financing amounted to PLN 1.1 billion. In the first edition of the programme, PLN 141 million was allocated to 28,437 applications. In the second edition, the amount of subsidies amounted to PLN 382 million, and the number of approved applications reached 76,464 (Cader *et al.*, 2021, p. 100). Among individual prosumers, the "My Electricity" support programme was the most popular. The fourth edition of the call for applications lasted until 17 March 2023, while the fifth was launched on 22 April and ended on 14 December of the same year. The National Fund for Environmental Protection and Water Management was responsible for the implementation of the programme. Under the programme, individuals could apply for funding not only for the purchase and installation of photovoltaic systems, but also for other energy efficiency equipment such as heat pumps, solar collectors, energy storage systems and energy management solutions in buildings. Financial assistance also covered costs incurred from 1 February 2020, provided that they related to installations operating under the net-billing system or concerned the transition from the previous net-metering model to the new billing method. In 2023 and the first quarter of 2024, the programme paid out funds for 78,429 photovoltaic installations with a total capacity of 480,236 kW, with an average capacity of 6.1 kW per installation. In addition, 5,158 electricity storage facilities and 3,998 heat storage facilities received subsidies. Among the provinces, Mazovia was the leader in terms of the number of subsidies for electricity storage facilities (916 payments), while in the case of heat storage facilities, the Małopolska Province was in the lead, with 739 such subsidies paid (*Rynek fotowoltaiki…*, 2024).

In January 2017, the Polish government discussed the recommendations of the Government Economic Commission on the necessary measures to reduce the high levels of air pollution affecting large areas of the country. As a result, fifteen key areas of action were identified to form the basis for the development of a national Clean Air Programme. An important element of this programme was to direct funding from the National Fund for Environmental Protection and Water Management towards initiatives that would significantly improve air quality. The aim was to ensure that every zloty allocated for this purpose would bring maximum benefits to public health and the environment. In response to these guidelines, the Clean Air Programme was created and implemented by the National Fund for Environmental Protection and Water Management. It was emphasised that improving air quality is one of the priorities of this project. It was pointed out that clean air is a global challenge. It was also noted that the programme aims to support the poorest, who cannot afford to invest (Sakson-Boulet, 2020, p. 172). The government's Clean Air Programme aims to reduce emissions of harmful substances into the atmosphere, which are the result of heating single-family homes with outdated heating systems and low--quality fuels. Under the Clean Air Programme, financial support is available for replacing old, inefficient heating equipment with modern equipment that meets the highest environmental standards, and also for carrying out thermal modernisation work on buildings. Thanks to investments supported by the Clean Air Programme, it is possible to manage heat energy in buildings more efficiently throughout the year. Insulating your home and replacing windows can reduce your annual heating costs by up to 40%. The programme is aimed at owners and co-owners of single-family houses or separate residential premises located in such buildings, which have a separate land and mortgage register (NFOŚiGW, 2024).

As part of the new approach to green energy transition in the European Union, the goal is to achieve a balance between carbon dioxide emissions and its natural absorption, for example by forests. Originally, it was planned to achieve this goal solely through renewable energy, but experience has shown that such a model is difficult to implement. Work is currently underway to develop energy storage technologies, including the production of green hydrogen, which is produced using renewable energy sources. There are challenges associated with its storage and transport, such as the risk of explosion or penetration by materials, which call into question its widespread use. At the same time, a new operating model is emerging in the energy system, in which energy supplies depend on the availability of production from renewable energy sources, such as wind or solar farms. Shortages in production may lead to the need to reduce energy consumption by consumers, and rising costs will make energy a luxury good. This new order poses major challenges for society and the economy, requiring adaptation on many levels. The main differences between renewable energy producers and prosumers stem from formalities and sources of income. Producers must run a business, hold a licence and sell energy at RES auctions, receiving support in the form of subsidies, while prosumers are private individuals who generate energy for their own use and benefit from subsidy programmes. However, the effectiveness of the prosumer system is questionable, as investment costs and the lack of energy storage facilities make it less profitable. Prosumers in Poland use so-called "net metering", i.e. the possibility of feeding excess energy into the grid and receiving it at another time, e.g. in the evening. In practice, conventional power plants, such as coal-fired ones, act as energy storage facilities, which puts an additional strain on the system. Nevertheless, decisions to become a prosumer are often influenced by social factors and administrative support that promotes RES installations, involving citizens' own funds, often without professional economic analysis (Mielczarski, 2021, p. 87).

Subsidy programmes play an important role in supporting households in investing in modern technologies while reducing the burden on the budget. By 28 November 2024, a total of over one million applications had been submitted under the Clean Air programme, half of which were submitted via the gov.pl platform. By 28 March 2025, approximately 874,000 agreements had already been signed, which means that most of the applications had been approved. Out of the PLN 38.1 billion pool resulting from the submitted applications, contracts worth PLN 29.5 billion were approved, but only PLN 15 billion has been paid out so far. This means that the payment process is still ongoing and a significant part of the funds is waiting to be transferred to the beneficiaries (NFOŚiGW, 2025).

Methodology

In order to achieve the research objective, methods for assessing the profitability of investment projects were used. The net present value (NPV) and the period required to recover the expenditure incurred (DPP) were calculated. This made it possible to estimate the moment when the expenditure incurred on the system will pay off for the owner. In the research, the interest rates published by the National Bank of Poland were used as the basis for discounting future cash flows.

The study analyzed a specific household case. It should be noted that households vary, and consequently, their energy consumption and savings metods differ; therefore, the micro-photovoltaic installations payback period should be determined under strictly defined conditions. Furthermore, many people are reluctant to disclose financial information, yet the methods employed in the analysis are based on cash flows.

The net present value was calculated according to the formula:

$$NPV = \sum_{i=0}^{7} \frac{CF_t}{(1+r)^t} \tag{1}$$

where:

CF_t – household savings as a result of the installation of photovoltaic panels (PLN),
r – discount rate (%),
t – period (years).

In order to estimate the payback period, the savings from subsequent years were accumulated.

In the household studied, the photovoltaic installation began operating in January 2021. The payback period specified in the agreement between the investor and the company implementing the project was 7 years. This means that by the end of 2027, the discounted payback period should not exceed 7 years and the net present value (NPV) should be positive. All financial decisions require a comparison of cash flows from different periods. The most recent data is from March 2025. This means that it is necessary to determine the future cash flows associated with the investment under analysis. Household savings resulting from the operation of photovoltaic panels were taken as the starting point. Monthly electricity bills were analysed, which specified both the price per kWh and the fixed charge, as well as the amount of production and consumption. These data became the basis for forecasting their future values. Using an Excel spreadsheet and the FORECAST.ETS function, the values of the variables necessary for the analysis were estimated – electricity production and consumption, prices per kWh, fixed charges and discount rates, which allowed for the estimation of future savings generated by the operation of photovoltaic panels. The values in the above function are predicted using linear regression. The confidence interval was set at 95%.

Evaluation of the profitability of investing in photovoltaic panels in a household – a case study

The building in question has a total usable area of approximately 162 m². The building also includes a basement with an area of 87.10 m² and a garage with an area of 46 m². The house was built with high-quality construction materials, which, in combination with the thermal insulation used, allows for comfortable living conditions in both summer and winter. Thanks to its appropriate design and the use of modern construction technologies, the building is highly energy efficient, which reduces heat loss and improves the household's energy balance.

The construction of the house was completed in December 2020. During this period, photovoltaic panels were installed, which began to produce electricity in January 2021. The installed photovoltaic system, with a total capacity of 4.62 kWp, consists of fourteen monocrystalline panels mounted on the roof of the building at an angle of 35 degrees to the south. This solution allows for the effective use of renewable energy sources and contributes to meeting the household's electricity demand. The house is located in an area with a temperate climate.

The heating system in the house is based on a pellet stove, which allows for efficient and environmentally friendly heating of the building. The installation achieves its highest efficiency in the summer, when sunlight is at its highest, making electricity production most effective at this time.

The cost of a photovoltaic installation in a household depends on many technical, financial and location factors. It is primarily influenced by the power of the entire system. In the household studied, it is 4.62 kWp. The higher the power, the higher the initial cost, but also the greater the savings in the future. It should be noted that the entire system should be adapted to the needs and size of the household. In the analysed period, there were noticeable surpluses of electricity in the summer months, when production from photovoltaic panels significantly exceeded current consumption (Fig. 1). This phenomenon is typical for PV systems, where maximum generation occurs during the months with the highest sunlight, while energy demand at this time is relatively low. These surpluses create potential for the development of energy storage, the sale of surpluses to the grid or the possible heating of buildings with electricity.

The second important factor is the type and quality of the panels used. Although more expensive, monocrystalline panels are more efficient than polycrystalline panels, which is extremely important when roof space is limited. The final price is also influenced by the choice of inverter – a device responsible for converting direct current into alternating current, whose quality and reliability are important for the effective operation of the entire installation. The installation in the household under study included modern monocrystalline panels and a reputable brand inverter, ensuring high efficiency and long system life.

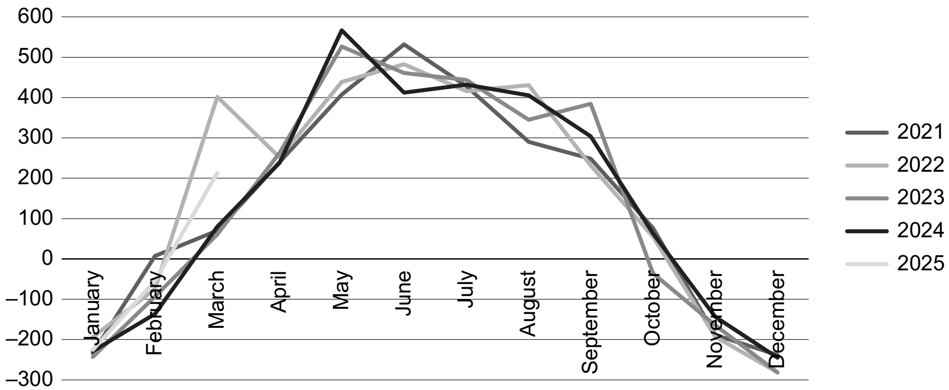

Fig. 1. Difference between energy production and consumption (kWh)
Source: own study based on documentation from photovoltaic system owners.

Another factor influencing the cost of the investment is the method of installing the photovoltaic panels. Installation on a pitched roof is usually cheaper and less complicated than installation on a flat roof or on the ground. In the case of the analysed household, the installation was carried out on a roof covered with ceramic tiles, which required the use of specialised mounting elements and increased the cost of the installation.

Additional costs may also be generated by the modernisation of the electrical installation if it is not suitable for connecting a new RES installation. In the farm under analysis, the installation of photovoltaic panels was planned from the outset, which was taken into account at the design and construction stage of the house.

The location of the household is also very important. In this case, the building is located in northern Poland and has a moderate level of sunlight, but with the right choice of installation power and appropriate panel positioning, it is possible to achieve satisfactory energy production.

In the household under study, the total cost of the photovoltaic installation was PLN 21,000. This amount included the purchase of photovoltaic panels, an inverter, a support structure for roof mounting, an electrical safety system, as well as the cost of installation by a specialised company. The investor also took advantage of funding under the government's "My Electricity" programme, as a result of which he received a subsidy of PLN 3,000. Thanks to this, the actual cost of the installation was PLN 18,000. The funding received covered 14% of the total costs.

The savings achieved in the first years of the investment have the greatest impact on its profitability (Tab. 1).

Table 1

Savings generated by the household as a result of the installation of photovoltaic panels and their discounted and cumulative values

Year	t	Savings (PLN)	Discounted savings (PLN)	Cumulative discounted savings (PLN)
2020	0	–	– 18,000	– 18,000
2021	1	1,278.35	1,256.37	–16,743.63
2022	2	1,396.56	1,225.53	–15,518.10
2023	3	1,617.77	1,367.97	–14,150.14
2024	4	1,637.18	1,309.10	–12,841.03
2025	5	1,906.40	1,441.49	–11,399.54
2026	6	2,062.87	1,406.67	–9,992.87
2027	7	2,214.53	1,357.15	–8,635.71
2028	8	2,320.40	1,262.80	–7,372.91
2029	9	2,521.98	1,204.44	–6,168.47
2030	10	2,690.03	1,114.20	–5,054.26
2031	11	2,796.02	992.77	–4,061.49
2032	12	3,022.77	909.49	–3,152.01
2033	13	3,173.56	799.92	–2,352.09
2034	14	3,321.18	693.38	–1,658.71
2035	15	3,481.39	595.28	–1,063.43
2036	16	3,664.55	507.50	–555.93
2037	17	3,820.87	423.86	–132.08
2038	18	3,888.44	345.40	213.33

Source: own study based on documentation from photovoltaic installation owners.

The forecast shows that from 2027 onwards, we will see a gradual decline in annual cash flows, which may be due to the decreasing efficiency of the installation or variable discount rates. Starting in 2030, cash flows will decline significantly, reaching only PLN 345.40 in 2038. This trend suggests that the greatest financial benefits from the investment are achieved in the first decade of use. After this period, the investment continues to generate profits, but these are increasingly lower. Although the nominal savings may be similar in subsequent years, their real value steadily declines because the later they are achieved, the less financial significance they have today.

The net present value (NPV) from the start of operation of the photovoltaic panels (January 2021) to the point at which, according to the provisions of the Agreement, the investment should pay for itself, i.e. the value of the indicator should be zero (by the end of December 2027), amounted to:

$$NPV = \sum_{i=0}^{7} \frac{CF_t}{(1+r)^t} = -8{,}635.71$$

The investment has not yet reached the break-even point, even though, according to the assumptions, it should already have paid for itself. The negative result indicates a delay in the implementation of the project's financial assumptions, which may be due, for example, to lower energy savings. Therefore, the research hypothesis should be rejected: the investment expenditure incurred by the household for the implementation of the photovoltaic investment, after taking into account the subsidy obtained, will not pay for itself within the period specified in the agreement concluded between the investor and the company involved in the installation and calculation of the profitability of photovoltaic panels.

The cumulative discounted savings will only reach a positive value in 2038. Only after that time will the investment begin to generate a real profit. Such a long payback period indicates that the project is only profitable in the long term and may be less attractive to investors expecting a quick return on their capital. Based on detailed calculations, it has been determined that the discounted payback period (DPP) is 17 years and 5 months. The lack of funding from the government's "My Electricity" programme would extend the payback period.

The question may arise as to whether the household could shorten the estimated payback period. The differences between the amount of electricity produced and the amount consumed indicate that there is a surplus of electricity. As already mentioned, the home heating system analysed in the household is based on a pellet stove. This raises the question of whether it would be possible to heat the house using the surplus electricity generated.

Figure 2 shows the changes in the demand for heating the house in kWh and the amount of unused energy produced from 2021 to March 2025. Between 2021 and 2023, the energy demand for heating homes remained at a similar level, with a slight increase in 2023. In 2024, there was a marked decrease in energy consumption. The amount of unused energy in the period under review was relatively low and remained stable. This trend indicates effective management of the energy produced. The small amount of surplus may indicate that the size

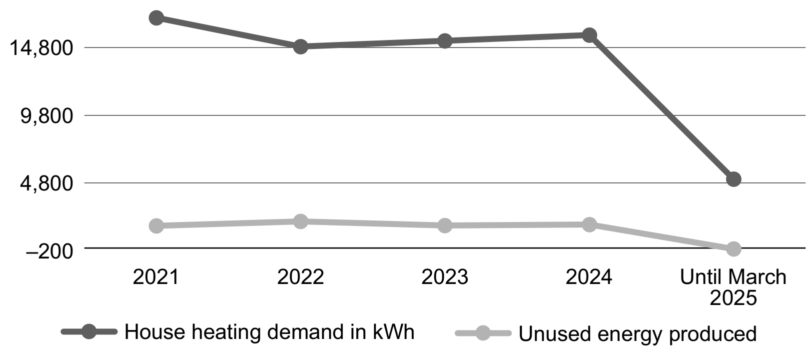

Fig. 2. Changes in the demand for heating the house and the amount of unused energy produced during the period (kWh)
Source: own study based on documentation from photovoltaic system owners.

of the photovoltaic installation is well suited to the household's needs. After analysing the energy demand for heating the house, it can be concluded that it would not be cost-effective to introduce electric heating due to the small amount of unused kWh. The energy produced is used for everyday purposes and to reduce electricity bills. The main purpose of installing photovoltaic panels was to cover the electricity demand for everyday use, without taking into account electricity-powered heating.

An overview of the energy demand for heating the house indicates that using electricity for this purpose would be unprofitable due to the small amount of unused electricity. The energy produced is largely consumed for the household's current needs. This contributes to lower electricity bills. Electric heating would require significantly higher energy surpluses, which are currently not available. This was a conscious decision on the part of the investor.

Discussion and conclusions

It is indisputable that the market for renewable energy sources, including in particular the photovoltaic market, will continue to grow. This is enforced, for example, by EU law, which the Polish government is obliged to comply with. Long-term forecasts reaching the middle of the 21st century indicate a 20-fold increase in PV capacity compared to the current level. Photovoltaics will become the world's largest source of electricity (International Renewable Energy Agency, 2022). Grudniewski and Ciekanowki (2024, pp. 207-208) even point out that, historically, official forecasts have often underestimated the actual increase in PV capacity, so these figures may also be underestimated. It should be emphasised that from 2030, all new residential buildings are to be zero-emission (European Commission, 2025).

The most intensive growth in the number of PV installations in Poland took place between 2018 and 2023, and among the main reasons for this growth were the "My Electricity" programme and the thermal modernisation tax relief, which significantly reduced the total cost of installation (Grudniewski & Ciekanowski, 2024, p. 208). Świdyńska and her co-authors (2025, pp. 68-90) analysed two variants of the profitability of investments in photovoltaic panels in households – one based on not using financial support programmes and the other assuming the use of the thermal modernisation relief and the "My Electricity" subsidy. In each of the three scenarios analysed (basic, pessimistic and optimistic), the investment was more profitable when subsidies were used.

A problematic issue is the fact that the payback period is underestimated in contracts concluded between the investor and the company responsible for the installation and calculation of the profitability of photovoltaic panels.

Nevertheless, with constant increases in electricity prices, investing in panels is a rational undertaking (Marciniak, 2021, pp. 149-162).

In the household studied, the payback period for the investment costs associated with the installation of photovoltaic panels was longer than that specified in the contract concluded between the investor and the company involved in the installation and calculation of the profitability of photovoltaic panels. The lack of subsidies would extend it even further.

Continuous technological development in the field of solar energy acquisition and utilisation may contribute to improving efficiency, reducing investment costs and increasing household savings. At present, the greatest incentive for households are government programmes that reduce the initial investment costs.

The results obtained may serve as a guide not only for the household analyzed but also for households in general. To shorten the investment payback period, one might consider measures such as changing the home heating method, switching to electric (and energy-efficient) appliances, and managing energy consumption rationally.

Translated by Author

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