



## Full length article

# Clean, accessible, and cost-saving: Reasons for rural household investment in solar panels in Poland



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## ABSTRACT

Solar energy utilization by rural households in Poland contributes to the EU-mandated increase in renewable energy use, while lowering emission, dependence on fossil fuels, and energy costs, and improving air quality. Using the survey data collected from owners of passive solar panels in rural areas, this study examines the importance of selected reasons in household decision to participate in the EU-funded solar panel subsidy program augmented by contributions from local governments and each household. Associations between nine reasons to invest in a solar panel and characteristics of respondents, their households, and solar panel features were examined using correlation coefficients. An ordered logit technique was also applied and calculations based on estimation results yielded probability changes in the relative importance attached to a selected reason for investing in a panel in response to a change in a respondent, household, or solar panel characteristic. The desire to save on energy used to heat space or water, and lower the energy bill as well as being unemployed or having part-time employment increased the probability of viewing the total cost, installation cost, subsidy, and the energy costs prior to having a solar panel as important. Those viewing the solar energy favorably were, overall, less likely to consider lowering the energy bill prior to putting a solar panel as important, while those perceiving solar panel features as troublesome were also less likely to view the listed reasons as important.

## 1. Introduction

Growth in the solar energy sector has resulted from European Union (EU) policies obligating all member countries to increase renewable resource utilization. Poland will generate at least 15% of its energy needs from renewable energy feedstock by 2020 (Dziennik Urzędowy, 2009). The share of renewable energy in total energy consumption in Poland reached 11.3% in 2016 (GUS, 2017). The EU created support programs encouraging households to invest in equipment that generates renewable energy, in particular solar energy. Solar energy usage has increased across Europe, including countries that are located in cool, temperate climate zones, e.g., Germany, Slovakia, and Poland. Germany leads among the EU countries in solar energy utilization, but the growth rate of installed solar thermal capacity in Poland exceeds that in Germany in recent years (Eurobserv'er, 2013, 2014, 2016). The possibility of solar energy in Poland attracted public attention: the size of passive solar panels had finally become suitable for installation on residential properties such as farm homesteads.

This paper examines the influence of panel attributes and rural

resident expectations associated with reasons for selecting a passive solar panel. Previous studies of Polish rural household attitudes towards renewable energy were general and did not focus on a specific type such as solar energy (Us et al., 2015). Although residential solar energy installations were subject to earlier studies, they focused on households operating in a very different environment and economic development level. An early study by Labay and Kinnear (1981) examined residential investment in solar energy utilization in the United States found that among socio-demographic characteristics of those adopting the new technology was education and occupation. Sidiras and Koukios (2004) researched households in Greece, a country with quite favorable solar radiation conditions, where solar energy was used in a way similar to that in rural households studied in the current study were, solar energy is used for heating water. The decision by Greek households to install solar energy equipment was driven by economic, socio-cultural, and technical factors as well as policy-based financial incentives. The decision to install solar panels was a multi-dimensional phenomenon. Labay and Kinnear (1981) suggested the longitudinal studies to observe the changes in the use of solar energy installations, but the collection of

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such data encounters practical and financial difficulties. Studies on motivation for residential solar installation adoption are still needed. Understanding specific reasons behind the choice and use of energy with regard to the specific source of renewable and freely available energy has been an infrequent subject of scholarly investigations because of the lack of data.

Insights about household preferences and energy conservation motives are needed despite grants supporting solar energy installations (Islam and Meade, 2013). Mazowieckie Voivodship receives 986 kWh/m<sup>2</sup> of solar radiation annually and only about 10% of the country's area receives more solar energy (Tymiński, 1997). The four counties which are the focus of this paper are located in the eastern part of the Mazowieckie Voivodship (region) in Poland. The solar panel owners in the area were surveyed in the spring of 2015. The four county solar energy utilization project was the largest of 19 county projects submitted in Mazowieckie Voivodship. Altogether, the projects in Mazowieckie Voivodship requested subsidies of 63 million Polish zloty for a total value amounting to 94.2 million Polish zloty (Rzeczpospolita.pl, 2014). Similar projects, although smaller in scale, were funded in other voivodships. For example, the six-county area in Lubelskie Voivodship (neighboring Mazowieckie) received funding for the purchase and installation of 852 sets of solar panels in 2013 (Gmina Parczew, 2018).

The survey participants in the current study have taken advantage of the renewable energy program which subsidized the purchase and installation of passive solar panels relatively recently. The program received substantial funding from the EU during the previous budget period 2013–2017. Generous financial incentives offered to households in other countries in the past included tax credits and tax exemptions (Crago and Chernyakhovskiy, 2017), but such instruments are not used in Poland. However, earlier studies established that rebates have large and significant effects on the adoption of solar energy utilization projects.

This study contributes to the existing literature on drivers of solar energy utilization in several ways. First, the study identifies the effects of respondent characteristics, household characteristics, and passive solar panel attributes that change the probability of viewing specific reasons as important in rural household decisions to invest in solar energy use. Second, the area examined in the current study is lagging in development and heavily dependent on burning coal primarily to heat space, and knowing what encourages or discourages the use of solar energy helps to effectively spread its use to other rural areas in Poland, the EU, and other regions. The insights gained from this study can be used for the implementation of solar energy utilization in lesser developed areas. Third, surveying owners of passive solar panels allowed for insights from actual users about panel attributes. Such knowledge was lacking and is sought by panel sellers and installers as well as government agencies in efforts to expand and enhance renewable energy utilization, including local governments directly administering the EU solar energy subsidy programs. New funds for similar subsidies have become available for the period 2014–2020 for Poland and other countries that lately joined the EU. Finally, as the regulatory regime changes, insights from the passive solar panel program can help to refine policy interventions, including financial support for residential photovoltaic panel investment which have become available only recently in Poland after the implementation of new regulations.

## 2. Solar energy utilization support program in Poland

The purpose of promoting solar energy use was to improve air and environmental quality, lower dependence on fossil fuels, and increase renewable energy use at the village level (Skolimowski, 2015). Approximately 78% of rural households in Poland used an average 2910.5 kg of coal in 2015 (GUS, 2017). The main incentive for passive solar panel installations was provided by the European Commission (EC) under directive No. 1083/2006 issued on July 11, 2006, which provided general regulations with regard to the European Fund for

Regional Development, European Social Fund, and Cohesion Fund. Funds are intended for EU member-countries with a per capita income below 90% of the average EU and are allocated in proportion to the country's population to realize goals consistent with EU policies, including environmental policies. The subsidy program for investors in solar energy panels corresponds to declared goals and funds considered in this study were awarded for the period 2013–2017.

Subsidy funds transferred from the EC to Poland's Ministry of Finance were distributed through Bank Gospodarstwa Krajowego (State Treasury Bank of Economic Development) to each of 16 voivodships, including Mazowieckie Voivodship, in 2010. The funds were distributed under the Regional Program of Mazowieckie Voivodship for the period 2007–2013 (Samorząd Województwa Mazowieckiego, 2017). The objectives of the Regional Program of Mazowieckie Voivodship corresponded to the objectives of the Strategy of National Development in Poland for the period 2007–2015. The subsidy program is a part of the priority area "Environment" within the EU Fund of Regional Development and the specific task "Air quality protection, energy generation". The task encompassed proposal for air quality improvement, energy security, increased use of renewable energy, and the need to limit air pollutants leading ultimately to environmental quality improvement through improved quality of the atmosphere.

To obtain a subsidy, a beneficiary, which in the case of this study involved four county governments, submits a project proposal to the regional entity managing the program. In the considered case, it was the office administering the Regional Development Program of Mazowieckie Voivodship called the Mazowieckie Unit of EU Program Implementation (MUEUPI). Once the project was approved and the agreement between the project beneficiaries and the regional government was signed, the subsidy was released by the Ministry of Development, engaged, among others, in regional development. The funds were disbursed at the instructions of the MUEUPI by Bank Gospodarstwa Krajowego after exchanging the funds received from the EC (denominated in euros) into the national currency, the Polish zloty.

The EU-originating funds could be used to cover up to 70% of the purchase and installation costs of solar panels by a homeowner. To distribute the EU funds in Poland, each voivodship government issued a call to its county governments to apply for subsidy funds under the provision that a county government adds another 15% of the costs from its own resources. The funds were distributed on a "first come, first served" basis. By late 2011, county governments that successfully secured subsidy funds called for individual residents to apply for funding under the stipulation that an awardee would pay the remaining 15% of purchase and installation costs. Consequently, the cost of purchase and installation of a passive solar panel was subsidized 70% by the EU and 15% by the county government, while the homeowner covered the remaining 15%.

## 3. Materials and methods

### 3.1. Rural household considerations and reasons for choosing solar panels

The attitudes towards the use of solar energy have been positive. Solar energy is non-polluting and readily available to anyone who chooses to utilize it. Mroczek (2011) reported survey results showing about 85% of Polish respondents acknowledged associating solar energy with renewable energy. A study of a single county, Sułoszowa in Malopolskie Voivodship, Poland, revealed that solar energy was one of the most well-known forms of renewable energy among the surveyed rural residents (Bednarowska et al., 2013). A similar opinion was formed among rural residents in Lubelskie Voivodship (Us et al., 2015). The solar support energy programs have been shown to enable access to clean, renewable energy and offered an opportunity to local residents (Devine-Wright, 2007). However, research indicates that general attitudes towards environmental issues are insufficient to explain the adoption of residential solar technology (Schelly, 2014). The change in

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