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Knock, knock! Who's there? A Latent Class Typology of Household Photovoltaic Investors

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EXTENDED ABSTRACT

Small-scale household PV installations are crucial for achieving carbon neutrality. Based on 2,500 responses from Czechia, Latent Class Analysis revealed six investor profiles with distinct, more or less differentiated mixes of environmental, economic, social and technical motivations. The groups are Environmentalists, Pragmatic Environmentalists, Economists, Self-sufficients, Technicians and Indeterminate. The findings highlight the need for targeted policies and communication strategies tailored to these diverse profiles.

Introduction / background

Photovoltaics (PV) represent one of the key renewable energy (RES) technologies in the carbon-neutrality transition. In the European Union, nearly 56 GW of new PV sources were installed in 2023, with small-scale residential installations accounting for about a third of this total. Understanding the behavior, attitudes and potential decision-making of private investors purchasing small PV sources is, therefore, crucial for further advancing sustainable development.

Household decision-making in the context of renewable energy investments is influenced by a complex mix of internal and external factors, often examined under the umbrella of the Value-Belief-Norm (VBN) and Theory of Planned Behavior (TPB) frameworks. Individuals are shaped by the structure and importance of their personal values and attitudes (economical, ecological, technical and societal), information perception and sociodemographic characteristics. Also, their attitude to the availability of subsidies, ecological impacts or normative societal pressures also significantly contribute to shaping behavior. All these various parameters influencing investment decisions can be conceptually reduced to four overarching decision-making factors - Economic, Ecological, Technical, and Surrounding, while the relative importance and influence of these factors differ significantly across individuals. Drawing on a dataset of more than 2,500 respondents (app. 14% response rate), this study examines the differential role of these factors and employs this analysis to identify latent classes of investors. The paper presents a comprehensive typology of six investor profiles and their defining characteristics.

Methodology

The dataset was collected through a questionnaire distributed in early 2022 via the State Environmental Fund of the Czech Republic. It includes responses from 2,565 households that had received subsidies for PV installations through the "New Green Savings Programme." The questionnaire covered four main areas: (1) importance ratings of four decision-making factors - Economic, Ecological, Technical, and Surrounding, (2) attitudinal statements, (3) technical and financial characteristics of the installations, and (4) sociodemographic information. Latent Class Analysis was conducted using the poLCA package in R across four data-preparation approaches and 40 model variants. From a methodological standpoint, one of the most significant challenges was handling response bias and converting continuous motivation scores into discrete categories appropriate for LCA. The use of normalized values helped mitigate the “yes-to-everything” effect, enhancing class separation

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and interpretability. The final model, a 6-class solution, was selected based on model fit criteria (BIC, AIC, entropy) and interpretability.

Results

Most respondents were aged 35–55 (52%) or over 55 (45%), with only 3% younger than 35. A majority held tertiary education degrees (58%), and over 65% reported monthly household income above EUR 1,600. Geographically, participants were drawn from across Czechia, though Prague and Central Bohemia were overrepresented. More than 64% lived in small municipalities (<5,000 inhabitants). Technologically, most systems were installed between 2019 and 2021, had capacities of 3–6 kWp, and included battery storage (78%) and/or heat storage (50%).

Respondents' motivations for installing PV systems were far from uniform. The six investor classes identified through LCA are:

1. **Environmentalists** (6%) – Younger, urban, and well-educated respondents who strongly prioritize ecological concerns and climate mitigation. They trust in the energy transition, actively monitor consumption, and are highly innovation-oriented. This group shows strong alignment with climate policy objectives.
2. **Pragmatic Environmentalists** (22%) – Balance environmental and economic motives. Often middle-aged and financially secure, they express high trust in state energy policy and perceive broad public support for renewables. Their motivations reflect integrated cost-benefit reasoning with strong value alignment.
3. **Economists** (16%) – Driven almost exclusively by financial considerations. Tend to be skeptical of environmental policy, have the lowest rates of electric vehicle adoption and battery usage, and often disregard non-financial benefits. They express the strongest disagreement with attitudinal shifts post-installation.
4. **Self-sufficients** (17%) – Seek independence from the system, placing strong weight on technical and economic autonomy. Common among older, higher-income respondents, they value operational control and system efficiency. Their attitudes are stable and minimally influenced by external narratives.
5. **Technicians** (5%) – Focused on system performance and technical reliability. Mostly male, higher-income individuals, often living in smaller towns. They are indifferent to ecological arguments and place little trust in state institutions, yet are interested in the technological aspects of energy systems.
6. **Indeterminate** (34%) – The largest and most demographically mixed group. They show weak or balanced motivation across all four factors. Older and lower-income respondents are overrepresented. Many installed PV as part of broader home renovations. They are the most open to changing attitudes post-installation and the most receptive to peer and expert influence.

Across all classes, the Economic factor played a role, but only 16% (Economists) were primarily motivated by cost, other were motivated also by non-financial motives—ecological responsibility, energy independence, or technical interest. The Indeterminate class showed the greatest behavioral flexibility and was the most policy-sensitive group.

Conclusion & discussions

The subjective element of final model selection (based on interpretability rather than pure statistical fit) remains a known limitation in LCA. Another limitation lies in sample composition: All respondents had already installed a PV system with public subsidy support. This means the findings are not representative of potential adopters or households excluded from the subsidy framework (e.g. renters or apartment dwellers). Future research should examine these “non-adopters” to understand structural and psychological barriers to entry. Finally, while this study focused on PV systems, the methodological framework is transferable to other low-carbon technologies (e.g. heat pumps, EVs, energy communities).