

Forward-Looking Framework for Accelerating Households' Green Energy Transition

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Abstract

Households play a crucial role in the energy transition, as they account for a significant share of final energy consumption and offer strong potential to improve energy efficiency, reduce emissions, and increase the use of renewable energy sources. However, the transition is complex and uncertain due to the diversity of consumer behavior, preferences, and living conditions. This project, funded by the Science Fund of the Republic of Serbia, aims to develop an innovative framework to guide household energy transition by integrating engineering approaches, participatory backcasting, and agent-based modeling (ABM). A representative survey of 1,033 households in Serbia was conducted to capture behavioral patterns, perceptions, and readiness for change, while renewable energy-based HVAC technologies were analyzed and categorized. A participatory backcasting (PB) methodology was developed to define long-term transition goals and desirable future scenarios for households. These qualitative outcomes support the creation of exploratory scenarios, which are further analyzed using an ABM, where households are modeled as agents based on empirical data. Initial results reveal key barriers, including low institutional trust, limited awareness of individual impact on local air pollution, and constrained financial capacity. Nonetheless, about one-third of households are willing to invest in transition measures, while 42% would accept subsidies, highlighting both the importance and limits of policy support. The framework was applied in the city of Vranje through an additional survey of 452 households and stakeholder workshops. Simulation of policy measures enabled the development of a local action plan, supporting evidence-based decision-making. The approach is flexible and transferable to other contexts.

Keywords (5 words): Households, Energy transition, Renewable energy, Serbia

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