School of Architecture, Civil and Environmental Engineering, ENAC
Environmental Engineering Institute, IEE
Laboratory on Human-Environment Relations in Urban Systems, HERUS

Master project

Exploring Triggers, Co-Adoption Patterns, and Spatial Contexts in the Residential Building Sector

Background and Motivation

The European Union's commitment to achieving net-zero greenhouse gas emissions by 2050 necessitates effective energy transition strategies at the local level. While policy measures aim to encourage households to implement energy retrofits, replace carbon-intensive heating systems, and adopt low-carbon technologies, gaps remain in understanding what triggers homeowners to initiate retrofits, how co-adoption patterns emerge, and the role of spatial contexts in shaping these decisions. Previous research has highlighted the influence of household context, attitudes, and social influence on energy renovation decisions, but the spatial dimension and co-adoption considerations remain underexplored. Currently, an inductive analysis of the drivers based on open-text responses using methods rooted in natural language processing is missing. Addressing these gaps is essential to developing targeted policy interventions that facilitate a faster and more widespread transition to sustainable residential energy use.

Goals

This thesis aims to build on findings from the project ABM4EnergyTransition, which analyzed energy renovation decisions among 2,410 homeowners in Styria, Austria. The objective is to investigate the spatial heterogeneity of energy retrofits and low-carbon technology adoption, identify key triggers that motivate action, and assess how co-adoption dynamics vary across different spatial contexts. The insights gained will help policymakers and local authorities design more effective, region-specific incentives for energy transitions in the residential sector.

Potential Research Questions

- What are the main triggers that lead homeowners to undertake energy renovations, and how do they differ by location and socio-economic factors?
- Is (co-)adoption behavior homogeneous across space, for instance, between urban and rural areas or in neighborhoods with different building stock characteristics?
- In which local contexts do households engage in energy retrofits and adopt low-carbon technologies, and what spatial scale is required to detect meaningful spatial patterns?
- How do household contexts, attitudes, and social influence vary across different geographic areas?

Methods and Requirements

Depending on interests and competencies, the thesis will employ geospatial data analysis to assess spatial adoption patterns, using Geographic Information Systems (GIS) and/or natural language processing methods, like structural topic modeling in R and/or Python for data analysis. Data from the ABM4ET survey will be leveraged to explore household characteristics and adoption behaviors. Knowledge of GIS, qualitative data analysis, and programming with statistical software is beneficial, while familiarity with survey data analysis is not required. German language skills would be an asset for working with the original survey dataset and contextual information.

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