

Adoption of energy efficiency measures and renewable energy by homeowners across three major Dutch cities

Ardak Akhatova^{1,*}, Erkinai Derkenbaeva^{2,3}, Eveline van Leeuwen^{2,3}, Solmaria Halleck Vega², Gert Jan Hofstede^{2,4}, Lukas Kranzl¹

¹ Technische Universität Wien (TUW), ² Wageningen University and Research (WUR), ³ Amsterdam Institute for Advanced Metropolitan Solutions (AMS), ⁴ North-West University, South Africa

*ardak.akhatova@tuwien.ac.at

1. Introduction

The low uptake of these measures, especially, among owner-occupiers, who are the major decision-making stakeholders (~57% of buildings in the Netherlands), is a major problem. Three groups of key determinants are found to be important renovation decisions by homeowners [1-3]:

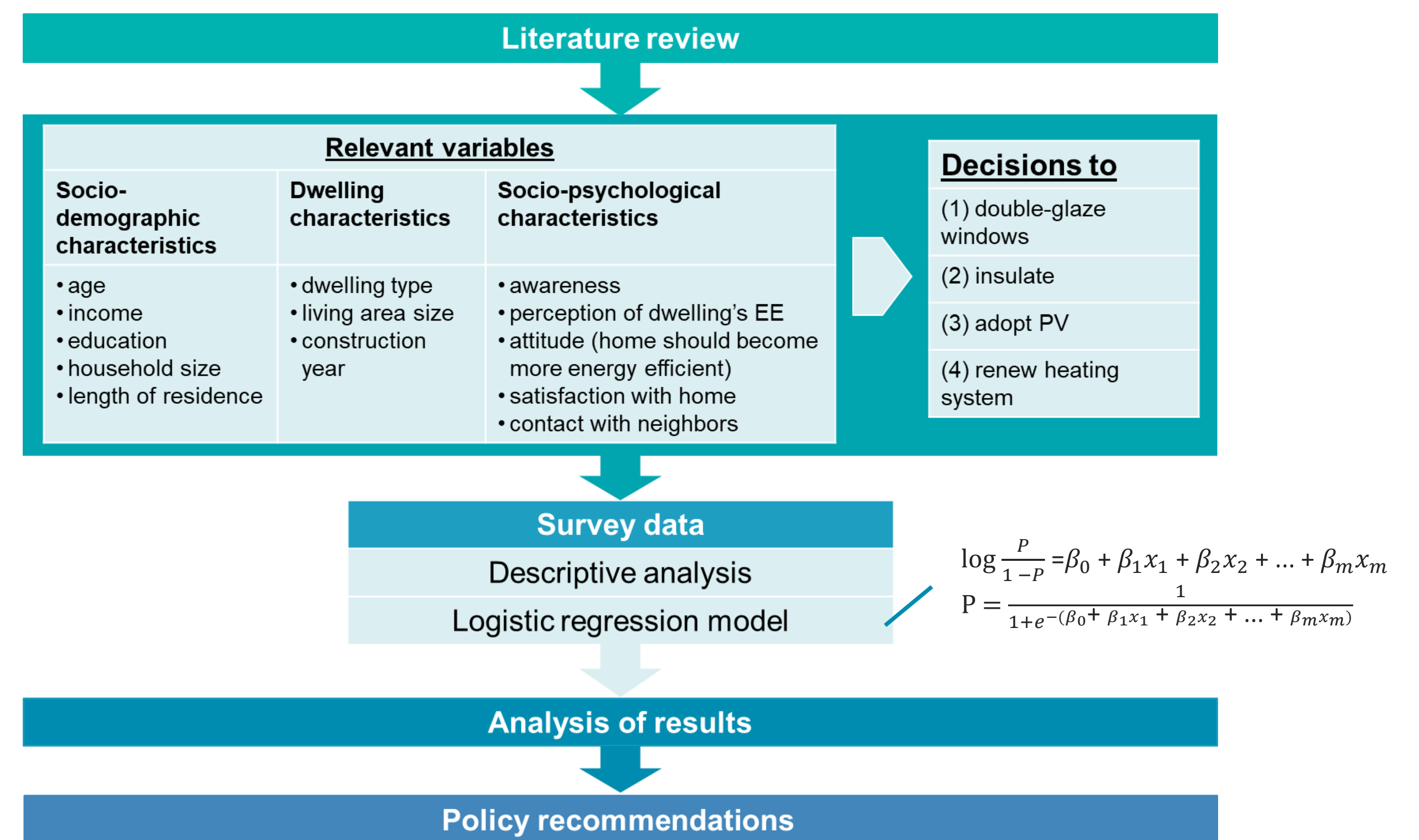
1. socio-demographic factors,
2. dwelling-related factors,
3. socio-psychological factors.

However, there is a lack of understanding about how these factors change across different locations, decision types (insulation, heating system and PV adoptions) and time.

Thus, the **aim of the study** is to explore which factors are correlated with different types of renovation in major cities as opposed to those identified on a country level.

2. Data and Methods

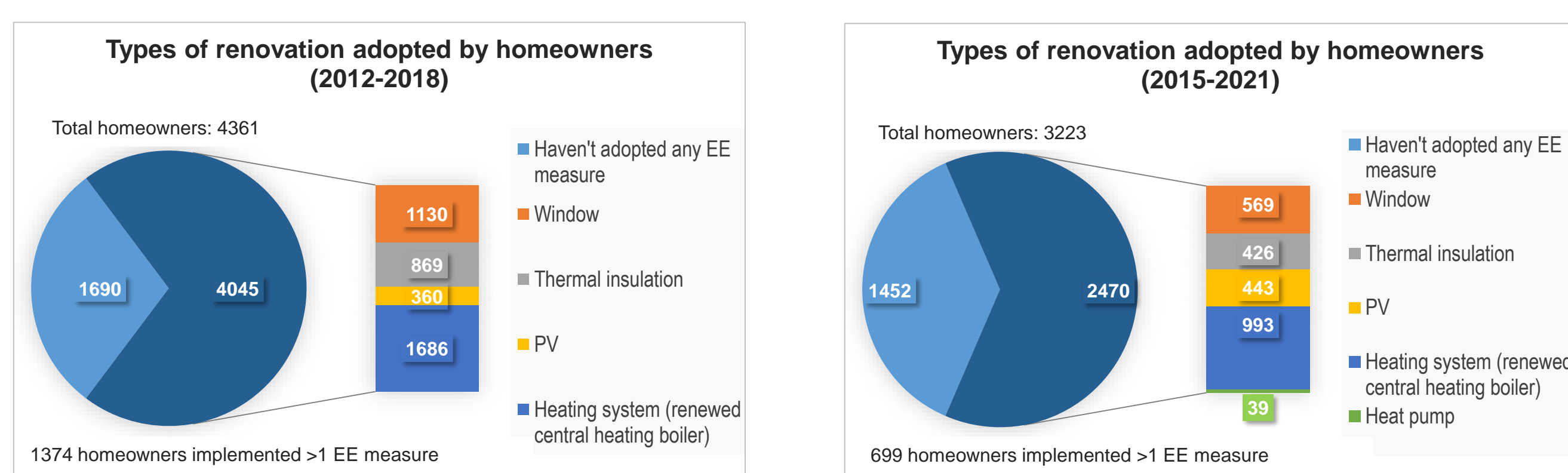
The workflow and the framework for logit models



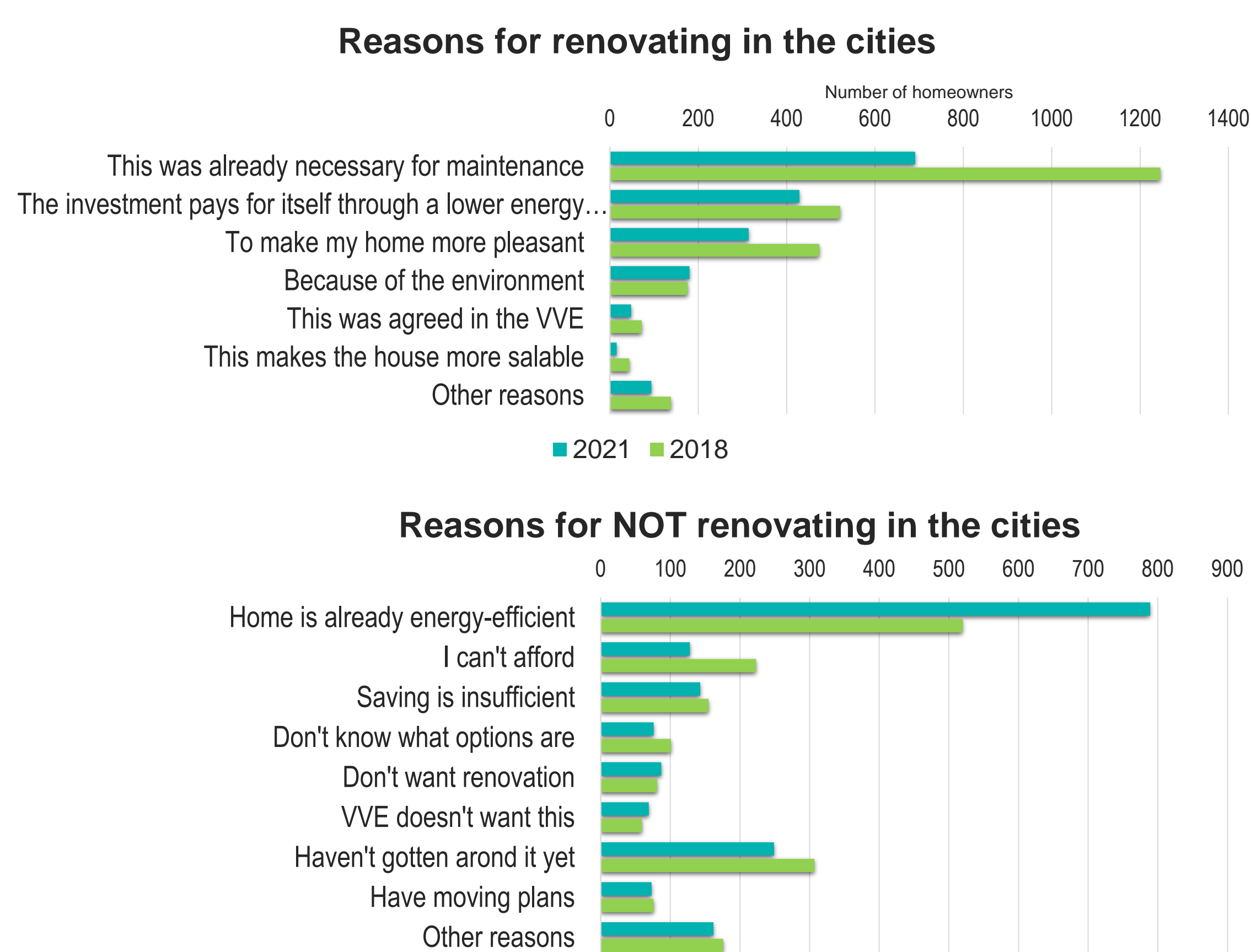
The two datasets from the Dutch Housing Survey (WoonOnderzoek Nederland, WoON) 2018 and 2021 were used [4].

3. Results

I. Uptake of EE measures in the cities



II. Reasons for (not) renovating



III. Correlated factors with different renovation decisions (2012-2018)

	Correlated factors
Double-glazed windows	DW: construction year (-), living area (+) SD: household size (+) SP: perception of EE (-), satisfaction with home (-)
Insulation	DW: construction year (-), dwelling type (* flat neg.) SP: perception of EE (+), attitude (+)
PV adoption	DW: dwelling type (* flat neg.) SD: length of residence (+) SP: perception of EE (+), awareness (+)
Heating system renewal	DW: construction year (-) SD: length of residence (+), income (+)

(+) – positively correlated, (-) – negatively correlated, (*) – based on category

4. Discussion

Replacement of a heating system is the most common measure, the reasons for renovating shows that majority renovated because it was necessary. Hence, making renovations mandatory might be an effective policy choice.

The strongest barrier towards renovation is homeowners' beliefs that their dwellings are already energy-efficient. Offering free energy audits could be a suitable solution. Secondly, many potential renovators "haven't gotten around it yet", which indicates uncertainty and need for support, e.g. via One-Stop-Shops or other intermediaries [5].

Homeowners in newer buildings are less likely to make thermal improvements and insulating buildings requires stronger motivation (attitude, satisfaction with home). PV adopters have suitable housing type (e.g. detached or terraced) and are environmentally-oriented.

5. Conclusion and Future Work

Retrofitting decisions should be considered separately by each type, as they have varying determinants. Performing the analysis at the level of cities hasn't brought added benefit and the results were similar to the country-level observations. Future work should focus on improving the method of analysing large national survey data (e.g. machine learning) to support policymakers.

References

- [1] Du, H. et al (2022). DOI: [10.1016/j.scs.2021.103560](https://doi.org/10.1016/j.scs.2021.103560)
- [2] Halleck Vega, S. et al (2022). DOI: [10.1016/j.enpol.2021.112659](https://doi.org/10.1016/j.enpol.2021.112659)
- [3] Ebrahimigharebaghi, S. et al (2021). DOI: [10.1016/j.enpol.2019.02.046](https://doi.org/10.1016/j.enpol.2019.02.046)
- [4] CBS (2021). <https://www.woononderzoek.nl/>
- [5] Akhatova, A. and Kranzl, L. (2022). In: eceee 2022, Hyères, France. [eceee.org](https://www.eceee.org)