Motivations and barriers of energy efficiency renovations in the residential sector: A review

Christian Vargas, Jonathan Villot

I CONGRESO DE POSTGRADO *fcfm*
INGENIERÍA, CIENCIAS E INNOVACIÓN

Motivations and barriers of energy efficiency renovations in the residential sector: A review.

Christian Vargas, Master in Management and Public Policies[1]; Jonathan Villot, PhD[2]
[1]University of Chile, [2] Mines Saint-Etienne, Univ Lyon, CNRS, Univ Jean Monnet, Univ Lumière Lyon 2, Univ Lyon 3 Jean Moulin, ENS Lyon, ENTPE, ENSA Lyon, UMR 5600 EVS, Institut Henri Fayol, F - 42023 Saint-Etienne, France.

Abstract

A bibliographical study through the analysis of articles and institutional/regulatory frameworks has been consulted to identify and classify the barriers and motivations for EER. This includes the analysis of studies in relation to Bibliometric networks and statistical methods for modelling decision making processes for energy renovations.

Introduction

Buildings are responsible for the 40% of the total energy consumption and the 28% of CO_2 emissions [1]. New regulations in many countries demand that by 2050 the residential sector will become carbon neutral. In France, the Low Carbon National Strategy (SNBC) is the main legal binding document which states the different objectives to achieve carbon neutrality.
However, only 6.6% of dwellings in France are low energy consumers [2]. This means that about 93% of the total residential sector must be renovated by 2050. This energy efficiency policy has been framed into a bigger context of energy poverty, which is important from the point of view of energy prices, energy policies and environmental objectives [3].

To achieve the SNBC's objectives, energy efficiency renovations (EER) in the housing sector are key to reduce energy consumption and carbon emissions. Also, as Kerr et al. have indicated, this is the path to tackle energy poverty and environmental challenges at the same time according to experiences in European countries such as the UK and Ireland (Kerr, N. et al., 2019) [3]. However, current challenges such as the increase on energy prices have been important for the implementation of policies supporting the SNBC (See figure 1).

In numbers, the SNBC aims to complete at least 500,000 renovations per year and at least 370,000 deep renovations per year starting in 2022. For that, homeowners might need to start renovating their houses with or without incentives, as well as tenants might need to adequate themselves to allow such renovations. There are many factors that might influence an EER decision which are classified as barriers and motivations. This research aims to understand and classify the underlying motivations and barriers for EER.

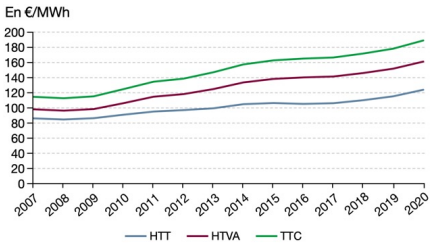

Figure 1. Evolution of energy prices (in €/MWh) for households from 2007 to 2020 in France. [4]

Methodology

A bibliographical study through the analysis of articles and institutional/regulatory frameworks has been consulted to identify and classify the barriers and motivations for EER. This includes the analysis of studies in relation to Bibliometric networks and statistical methods for modelling decision making processes for energy renovations.

This is the first part of this research, which aims to complement the bibliographical analysis with data analysis using R studio and statistical methods. The data will be obtained from open-data sources, and it will analyze more than 250,000 houses located in France. The case study will lead to the support of the factors that most influence the decision-making process on EER in the residential sector.

Results

Motivations and Barriers are mainly sub-classified as economic and non-economic factors [5]. Different methodologies have been applied to the study of such barriers and motivations to understand the decision-making process of property-owners to renovate their homes. Bibliometric networks have been a useful tool to understand thematic areas for modelling decisions, while other authors have analyzed the subject through models of energy consumption behavior [3]. Among the main economic barriers are the payoff period for the investment, upfront costs and investment and aversion to loan, while for economic motivations the most named are the increase of energy prices and the increase of the property value. Misinformation and uninterest are among the most named non-economic barriers, but reduce on energy consumption, lower environmental impacts, and improve of thermal, acoustic and noise comfort are among the most named non-economic motivations. The identification and classification of the main economic and non-economic barriers and motivations for EER are a useful input to build EER models and to compare them with the trends that can be found through the analysis of open data.

	Motivations	Barriers
Economic	- Increase in energy prices - Increase in property value	- Pay-off period - Upfront costs Investment and aversion to loan
Non-economic	- Reduce in energy consumption - Lower environmental impacts - Improve thermal, acoustic and noise comfort.	- Misinformation and uninterest - Implementation of EER policies at a local level is insufficient.

Figure 2. Main motivations and barriers found through a bibliographic analysis of EER decision-making processes.

During initial modelling using multiple linear regression (MLR) methods other factors such as the type of user of the dwelling (homeowner or tenant), the distance to patrimonial buildings (classified as historic monuments), income and the size of the dwelling were significantly important in relation to the explanation of energy consumption of a dwelling. This will require further analysis and more likely re-modelling selecting another mix of economic and non-economic variables available according to the open-data sources, but these named factors are in relation to some bibliographical studies.

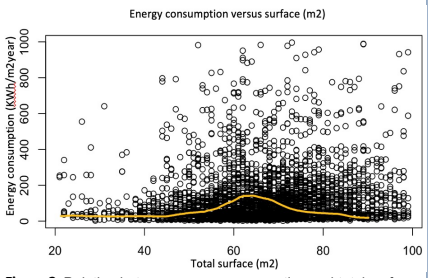

Figure 2. Relation between energy consumption and total surface of a set of dwellings in the Department of 'La Loire' (France).

Conclusions

This research aims to find out the main motivations and barriers affecting the decision of homeowners to renovate their homes. Extensive research has been done to determine economic factors affecting EERs, but it is still lacking a more comprehensive research taking in consideration non-economic factors (motivations and barriers) affecting EER. This research has highlighted the most important motivations and barriers, and in a second step will study a case with open-data to find out a quantitative model that justify such factors. Other methods such as the Multiple-criteria decision making might be useful to explore for this subject. In addition, it is recommended that governmental housing, socio-economic and energy open-data are available in a format that can be analyzed through spatial analysis for a better link between all these variables.

Acknowledgments

Thanks to the Chile-France co-financing program: "Support for research cooperation for master and doctorate in its 2022 version".

Contact

Christian Vargas Y.
Master in Management and Public Policies (c) at University of Chile;
Visitor Researcher at École des Mines de Saint-Étienne (France).
Email: christian.vargas@emse.fr

References

1. European Commission. Clean Energy for all Europeans package (2020) [Online]. Avaliable: https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en#energy-performance-in-buildings [accessed: 28.04.2022]
2. National Observatory for the Energy Renovation.
3. Kerr, N., Gillard, R., & Middlemiss, L. (2019). Politics, problematisation, and policy: A comparative analysis of energy poverty in England, Ireland and France. *Energy and Buildings, 194*, 191–200. https://doi.org/10.1016/j.enbuild.2019.04.002
4. Ministère de la Transition Écologique. (2021). Prix de l'électricité en France et dans l'Union européenne en 2020.
5. Friege J. and Chappin E. Renewable and Sustainable Energy Review 39, 196-208. https://doi.org/10.1016/j.rser.2014.07.091