

# Removing Behavioral Barriers to Energy Renovation: A Discrete Choice Experiment

Corinne Chaton\*, Valérie Lesgards\*\*, Samy Zitouni\*\*

---

## ABSTRACT

Through a discrete choice experiment conducted among French homeowners, we determine whether easing financial constraints through two financing programmes (third-party financing and Energy Efficient Mortgages) leads to an increase in the adoption rate of energy-efficient renovations. We examine whether the introduction of a contractual mechanism that intrinsically promotes trust between the parties (one-stop-shop) can increase the adoption rate. Among other things, our study reveals certain preferences among households with regard to financing energy-efficient home renovations and assesses certain cognitive biases. We find that both financing programmes increase the probability of choosing an energy renovation over the opt-out option. Nevertheless, participants exposed to the mortgage programme have a preference for the status quo (not renovating), unlike those exposed to third-party financing. With the latter financing programme, the effectiveness of the work seems guaranteed, unlike with the mortgage. This explains why the group offered the energy-efficient mortgage is more inclined to choose renovation scenarios that include an administrative facilitator, highlighting the importance of procedural support and risk transfer in the decision-making process.

*The authors are solely responsible for this work with no engagement from the institutions to which they belong.*

**Keywords:** Discrete Choice Experiment, Energy-Efficient Renovation, On-bill financing, Energy Efficient Mortgages, One-stop-shop

**JEL:** Q4, C25

\*CREST and Finance for Energy Market Research Centre (FIME), France. E-mail: [corinne.chaton@ensae.fr](mailto:corinne.chaton@ensae.fr).

\*\*EDF R&D

\*\*Paris School of Economics, Université Paris 1 - Panthéon-Sorbonne, Paris, France. E-mail: [samy.zitouni@psemail.eu](mailto:samy.zitouni@psemail.eu)

## 1. INTRODUCTION

Residential energy consumption represents one of the primary contributors to both total energy use and greenhouse gas (GHG) emissions in France. In this context, Energy-Efficient Renovation (EER) offers both environmental and social benefits for public authorities by reducing energy demand and therefore associated CO<sub>2</sub> emissions, as well as fuel poverty. It thus plays a pivotal role in advancing climate mitigation strategies and achieving the French national objective of carbon neutrality by 2050. In recognition of this, the French government has set ambitious targets for the energy renovation of the residential building stock. While approximately 80% of the 2023 target of 90,000 high-performance renovations was met, the substantial increase in the 2024 objective to 200,000 such renovations was followed by a considerably weaker response from households, with only 45% of the target reached.<sup>1</sup> Current energy renovation practices are largely limited to low-impact, partial interventions delivering relatively modest efficiency gains.<sup>2</sup> However, in order to encourage energy renovations, the French government had put in place various forms of assistance/schemes.<sup>3</sup> But, existing policy instruments appear insufficient to encourage comprehensive, high-performance renovations, which remain costly and are often perceived as risky, particularly in a socio-political climate that has become increasingly contentious toward renovation mandates, mainly due to inefficiencies in previous policy schemes.

Our objective is not to provide an analysis and evaluation of the various financial instruments put in place by the French government to encourage EER of housing. This analysis and evaluation has already been carried out at European Union level by [Bertoldi et al. \(2021\)](#). As these authors point out one of the obstacles to EER is the inability of many households to finance it despite the aid available. For these households, on the one hand, the remaining costs may be too high, and, on the other hand, they do not have the financial capacity to advance the cost of the work. Of course, this aid can be supplemented by bank loans. However, these loans are intended for households that meet certain criteria (solvency, no elderly or sick people, etc.) and are rarely sufficient to finance EER.

Furthermore, like any economic decision, a decision or transaction related to the energy renovation of a home involves risks inherent in the transaction itself. These risks include the risk of not finding the right renovation offer, the risk of poor-quality work and risks related to uncertainty

<sup>1</sup> Agence Nationale de l'Habitat (*French National Housing Agency*).

<sup>2</sup> 569,243 dwellings were partially renovated in 2023.

<sup>3</sup> These schemes include reduced VAT rates, grants and subsidies from the National Housing Agency, regulated loans (such as the Eco PTZ, sometimes combined with MaPrimeRénov (a government subsidy that helps finance major energy-efficient renovations – improving the energy rating by at least two classes), or the Prêt Avance Rénovation (PAR), which is a mortgage loan.

about the results, i.e. improved comfort and energy savings. Risk aversion, which can be measured using various tests, including questionnaires, leads to a bias in favour of the status quo, i.e. novelty is perceived as bringing more risks than benefits. This leads to resistance to behavioural change among individuals. Uncertainty therefore also plays a central role in their decision-making process (Bakaloglou and Belaid (2022)), with heterogeneous responses depending on expectations regarding future economic conditions (e.g., energy prices) and the perceived technical quality of retrofit works. This latter form of uncertainty is particularly salient in the French context, where retrofit policies have been undermined by negative past experiences. Several subsidy schemes were discontinued following widespread misuse by retrofit professionals, who, shielded from accountability due to the administrative design of the programs, often prioritized profit over quality. As households were not directly managing their applications, quality control was weak, leading to substandard outcomes. This has contributed to widespread distrust and negative word-of-mouth, especially in a context of high renovation costs. Existing quality assurance mechanisms, such as professional certification schemes, have so far failed to restore confidence, and no credible mechanism currently exists to guarantee trust among stakeholders.

In light of these findings, we asked ourselves the following two questions:

1. Does alleviating financial constraints lead to a higher adoption rate of energy renovations?
2. Can the introduction of a contractual mechanism that inherently fosters trust between parties significantly increase this adoption rate?

To answer these questions, we designed and implemented a Discrete Choice Experiment (DCE) involving a representative sample of 513 French homeowners. The Discrete Choice Experiments were developed in the 1970s by McFadden (1972) who formalized the way individuals make discrete choices between different alternatives using the random utility model. Although they have been widely used in the medical literature since the 1990s (Propper, 1990; Ryan and Wordsworth, 2000; Farrar et al., 2000; de Bekker-Grob et al., 2012), their use in the field of environmental economics is older (Beggs et al., 1981; Hanley et al., 1998). Energy efficiency, a part of the environmental economics literature, has attracted the interest of researchers to conduct discrete choice experiments to show, among other things, that energy efficiency is more than just a trade-off between operating costs and benefits. Participants are usually presented with a series of hypothetical choice sets, each defined by a combination of attributes with varying levels. For each set, they are asked to select their preferred option. This approach enables to infer individual preferences and trade-offs across attributes, based

on the choices observed and on hypothesis they are made based on a random utility model [McFadden \(1972\)](#). With this approach, we test the interest of French owner-occupiers in two financing methods described as innovative instruments by [Bertoldi et al. \(2021\)](#), namely *On-bill finance* and *Energy Efficient Mortgages*.

Hence, one of our objectives is to assess how participants value two alternative funding schemes in the context of energy-efficient renovation decisions. Both financial instruments eliminate upfront payments and propose innovative repayment mechanisms that seek to reduce perceived financial and behavioral barriers. The first scheme (*on-bill finance*) operates through a third-party performance-based contract, in which households incur no out-of-pocket expenses. Repayment is structured as the full amount of energy savings over time, thereby eliminating both financial exposure and performance risk for the household. While households do not directly benefit from monetary savings, they may still value the improved thermal comfort, aesthetic enhancements to their home, or social recognition associated with undertaking such renovations. The second scheme resembles a deferred-payment mortgage. Households face no initial expenditure, and repayment occurs upon sale or succession, within a maximum period of ten years. If the property is not sold within this timeframe, a contract renewal is proposed, with updated interests. In this case, households can potentially realize direct financial gains through energy savings during the occupancy period, as well as increased property value, which may offset the final repayment amount upon sale.

Our study examines whether of these two funding schemes reduces this bias in favour of the status quo. Can these funding schemes eliminate behavioural barriers to energy renovation? These barriers, which have been addressed by numerous authors, are “*split incentives, lack or inadequate information about costs and (co-) benefits, high upfront investment costs, decision-making process (van Oorschot et al., 2016), lack of access to finance (Bertone et al., 2018), and scarcity of available private capital (Vogel et al., 2015)*.” ([Bertoldi et al., 2021](#)). To our knowledge, this is the first DCE devoted to renovation financing methods. Through this experiment, we are also studying the dispossession bias.<sup>4</sup>

The schemes are tested one by one on a randomly selected half of the population. By offering

<sup>4</sup>Risk aversion is asymmetrical: individuals do not perceive losses and gains in the same way. There is therefore a reference point against which changes are perceived. These changes are not perceived in absolute terms, but relative to this reference point (see [Kahneman and Tversky \(1979\)](#)). This explains dispossession aversion. People tend to value something more when they own it than when they do not. In connection with this cognitive bias, which is an asymmetry in aversion to dispossession, we tested third-party financing and Energy Efficient Mortgages. From a strictly normative point of view, these two mechanisms are identical, but they differ in terms of reference points for the individual. For individuals, a mortgage is perceived as dispossession.

either third-party financing or energy efficient mortgages for the renovation of owner-occupied homes, we study the bias in favour of the status quo and the dispossession bias. We test a third fundamental factor of risk aversion, namely transaction costs (Allen, 1991; Ebrahimigharehbaghi et al., 2020). When a household wants to renovate its home, it must search for a lot of information. This involves a cost, and there is also a significant asymmetry between the information available to sellers and that available to buyers. Our experiment also aims to measure these transaction costs by proposing both groups the services of an administrative facilitator (a One-Stop-Shop (OSS) Operator) who provides comprehensive assistance, researches all available financing options for households, finds certified and trusted construction professionals, and develops an optimal offer based on the household's situation (Bagaini et al., 2022).

For both groups (one offered an energy efficient mortgage and the other third-party performance-based contract), using econometric models (more specifically, multinomial logits described in Section 2.3) we analyze participants' preferences over different renovation scenarios and an opt-out option. The results show that, on average, participants exposed to the mortgage-based programme prefer not to renovate their homes. We expected this result, as mortgage guarantees do not have a good reputation. We do not observe this preference for the status quo in the group exposed third-party financing. This type of financing, like a mortgage loan, means that the household does not have to pay for the work up front, but unlike a mortgage loan, there is no risk of losing the property and, in addition, the effectiveness of the work seems guaranteed, as the third-party financier is repaid from the energy savings achieved.

The group for which the energy efficient mortgage was offered showed a higher propensity to select renovation scenarios that included an administrative facilitator, underscoring the importance of procedural support and risk transfer in the decision-making process. In contrast, participants presented with the third-party performance-based scheme were more inclined to choose retrofit options over the opt-out alternative. Not only did the presence of this scheme increase the probability of engaging in renovation, but it also positively influenced the intensity of the renovation effort, as reflected in the choice of more comprehensive retrofit scenarios. Willingness-to-pay (WTP) estimates suggest that many households possess a relatively accurate perception of current retrofit market conditions, particularly with respect to cost-benefit trade-offs. This observation supports the hypothesis that households may be waiting for a credible policy signal or a supportive intervention to overcome inertia. In light of our findings, third-party financing mechanisms appear to be particularly well-suited to advance France's ambitious decarbonization targets by both mitigating risk and enhancing trust

in the renovation process. In a broader reflexion, finding a way to guarantee quality better than the current guarantees provided by the French legal system should be a priority, especially facing the high costs of retrofits. It may not be a problem of costs alone but rather an issue of cost-risk analysis for households.

We present in Section 2 our detailed DCE design as well as the sample of participants we collected. We also recall the theoretical foundations of choice models and the ML model. Eventually, we present our different results in Section 3, that we enlarge and discuss from a policymaking point of view in Section 4 and Section 5.

## **2. DATA AND METHODOLOGY**

### **2.1 Data and design of the Discrete Choice Experiment (DCE)**

This study relies on data from a DCE conducted in the spring of 2024. Qualified participants are owner-occupiers of houses, with the aim of ruling out. Participants were recruited via Verian's *Public Voice* probability panel. We deliberately restricted the sample to owner-occupiers of individual houses, excluding both tenants and apartment owners. This choice was made to avoid the landlord-tenant decision-making dilemma, and to ensure that participants had full autonomy over renovation decisions. In the case of apartment owners, retrofit actions are often constrained by condominium regulations, which limit individual decision-making and complicate the attribution of preferences in the context of energy renovation. We believe that participants are therefore better at projecting retrofit scenarios for their homes. The sample is representative of French homeowners when compared to INSEE's Statistics on Resources and Living Conditions (SRCV) 2023 survey<sup>5</sup> as shown in Appendix C.<sup>6</sup>

The survey was administered online and structured in three main sections. In the first part, participants provided detailed information about their homes, including intrinsic characteristics (such as surface area, number of rooms, and Energy Performance Certificate rating) as well as subjective perceptions of indoor conditions (e.g., feeling of cold or humidity).<sup>7</sup> This section also included questions on their expectations regarding the future economic outlook and any past experience with home energy retrofits. We consider this initial section as a form of cognitive anchoring, aimed at

<sup>5</sup>Statistics on Resources and Living Conditions survey: doi:10.13144/lil-1710 Statistiques sur les ressources et conditions de vie (SRCV) - 2023, INSEE (producer), PROGEDO-ADISP (distributor).

<sup>6</sup>INSEE (Institut national de la statistique et des études économiques) is the National Institute of Statistics and Economic Studies in France.

<sup>7</sup>In France, the energy performance certificate (EPC), a document issued for each property put up for sale or rent, provides detailed information on its energy efficiency. The scale ranges from A to G. The most energy-efficient properties are classified as A and the least efficient as G.

preparing participants for the subsequent discrete choice experiment (DCE) on retrofit scenarios. The second part introduced the DCE itself, including a quick explanation of the task, finance schemes, and the hypothetical scenarios presented. Finally, the third section collected standard socio-economic data, including household income, composition, and geographical location as well as Holt and Laury's test (a risk aversion test) (Holt and Laury, 2002). The survey was designed to last around a maximum of 20 to 25 minutes, to avoid participants fatigue.

### *2.1.1 Attribute selection*

The core principle of DCEs lies on a hypothesis about the think mechanism of participants. Buildings scenarios, experiment makers must try to anticipate what process can be in the mind of a respondent when seeing a scenario. We ask participants to choose based on what they see, that is to say values of the attributes.

Retrofit scenarios were framed as hypothetical renovation projects proposed for participants' own homes by an entrepreneur specialized in energy retrofits. We deliberately chose not to associate each alternative with a specific type of renovation work, in order to leave participants free to imagine which upgrades would be most appropriate given the characteristics of their dwelling. However, we did provide illustrative examples to help them visualize what such retrofits might entail. Importantly, we emphasized that the primary objective of the proposed works was to improve the energy efficiency of the dwelling. While aesthetic-related improvements could be considered as co-benefits, purely cosmetic renovations were explicitly ruled out as standalone motivations.

Each alternative in the choice experiment is described using five attributes. Three of them, total cost, expected energy savings, and comfort improvement, are widely used in the literature on household preferences for energy retrofits (see, e.g., Bakaloglou and Belaid (2022), Galassi and Madlener (2017), Fanghella et al. (2023)). In addition, to meet our objectives, we include two binary (dummy) attributes that capture institutional and implementation aspects of the retrofit. The first indicates whether the option is supported by one of the two financing schemes introduced in the survey (e.g., a third-party payment or an Energy Efficient Mortgage). The second indicates whether or not there is a One-Stop-Shop (OSS) Operator.

**THIRD-PARTY SCHEME: ON-BILL FINANCE.** One of the financial instruments presented in the experiment is a Third-Party Scheme (TPS). The concept of third-party financing is not new in the French context. Third-party financing companies, defined by Articles L. 381-1 et seq. of the

Construction and Housing Code, are integrators created on the initiative of local authorities.<sup>8</sup> This incentive mechanism was set up to remove barriers to investment in EER, both for private individuals and for collective residential buildings. The third-party organisation is responsible for both carrying out the work and providing all or part of the financial resources required. In our setup, participants were told that a trustworthy and certified third-party actor would fully finance the renovation works, requiring no upfront payment from the household. In return, the household would commit to allocating its entire post-retrofit energy savings toward reimbursing the cost of the intervention. The contract was described as being based on a prior energy audit to determine baseline consumption. Although in real-world applications repayment is often based on a share of energy savings, we chose not to introduce this level of complexity in the survey to ensure respondent comprehension. Thus, households to which we offer third-party financing receive a card containing the following information.<sup>9</sup>

**THIRD-PARTY SCHEME: ON-BILL FINANCE.** A company advances the cost of the work, so you don't have to pay anything before or during the work. You repay the advance through the energy savings you make, i.e. the reduction in your energy bill. All your energy savings are used to finance the repayment of the work. Once the repayment is made, you benefit from your energy savings.

A central feature of the TPS is that the third-party actor also assumes full responsibility for the implementation of the retrofit works. This design element is particularly relevant in the French context, where there has been widespread public distrust toward renovation professionals, partly due to historical misuse of public subsidies and concerns about the quality of delivered work. In this framework, the third-party entity has a strong financial incentive to ensure that energy savings materialize, since its repayment depends on them. As such, this scheme not only shifts the financial burden away from households, but also transfers performance risk to a professional actor better equipped to manage it. We view this mechanism as a potentially effective way to align incentives and enhance trust in the retrofit process, by integrating both the technical feasibility and household needs into a contractual agreement.

By introducing this financing scenario, we aim to assess the extent to which participants are attracted to a retrofit option that eliminates both the financial burden and the uncertainty typically

<sup>8</sup>[Code de la construction et de l'habitation - Article L381-1.](#)

<sup>9</sup>As mentioned in the introduction and explained in subsection 2.1.2, participants in the experiment are divided into two groups. One group is offered third-party financing and the other a mortgage loan.

associated with energy renovation. In this setting, the costs and performance risks are entirely absorbed by the third-party provider. As a result, the household does not perceive any upfront cost, nor does it bear the risk of underperformance. However, this comes with a trade-off: the household does not directly benefit from the energy savings, as these are fully allocated to repaying the third party. The only tangible benefits are non-monetary, such as improved thermal comfort, aesthetic enhancement, increased property value, or potential social recognition.<sup>10</sup> Therefore, willingness to opt for this scheme provides valuable insights into the perceived barriers to energy retrofitting. A strong appeal for this option may indicate that financial constraints and the risk that the renovation will not be energy efficient are the main obstacles to renovation uptake among homeowners.

**ENERGY EFFICIENT MORTGAGE.** The other financial instrument presented in the experiment is the Energy Efficient Mortgage (EEM). This financing mechanism is more conventional and familiar to most households. Under this setup, a financial institution covers the full upfront cost of the renovation works. In return, it secures a mortgage on the property that includes both the capital outlay and accrued interest. Participants are informed that the contract spans ten years, during which two outcomes are possible: if the owner decides to sell the property before the term, the outstanding amount is automatically deducted from the sale price. If not, a renewed contract is proposed at the end of the term, with updated interest rates and a revised maturity date. Participants who are offered this financing mechanism receive the following information:

**ENERGY EFFICIENT MORTGAGE (EEM).** A company or bank advances you the cost of the work. You don't have to pay anything when the work is finished. You repay the advance when you sell your renovated home, if you or your heirs inherit it. If you have not sold your home by the end of the 15th year, you will have to repay the advance.

Therefore, with EEM, respondents were informed that household bears no initial financial burden. They retain full access to the benefits of the retrofit: reduced energy bills, improved thermal comfort, enhanced social status, and increased property value. We anticipate that preferences for this option may differ from those for the Third-Party Scheme (TPS), for at least two reasons. First, mortgage schemes involve a legal charge on the dwelling, which may trigger concerns about ownership and potential dispossession, particularly in a context of general mistrust towards financial institutions. Second, in France, mortgage-based instruments are often associated in public discourse with financial

<sup>10</sup>It should be noted that in this study, among the non-monetary benefits, we only quantify the willingness to pay for improved comfort (see Section 3).

hardship rather than as tools for facilitating investment, potentially reducing their attractiveness. EEM schemes already exist within the broader landscape of French renovation policies. However, these instruments are primarily targeted at lower-income households.<sup>11</sup> The structure is similar to the scenario presented above, in that the financing is secured against the property, and repayment is deferred until the property is sold, or even passed on through inheritance, with repayment occurring upon succession.

**ONE-STOP-SHOP OPERATOR.** Additionally, we include a One-Stop-Shop (OSS) operator in the design, introduced as a facilitator aimed at removing administrative bottlenecks throughout the retrofit process. The OSS is presented to participants as a trusted intermediary that coordinates the different stages of the renovation, ranging from the technical assessment to the selection of contractors and the management of subsidy applications. The following information is provided to all participants.

**ONE-STOP-SHOP (OSS) OPERATOR: A MANAGER-OPERATOR FOR RENOVATION.** A company offers comprehensive assistance that allows you to: 1) find all the financing you are entitled to; 2) find trusted construction professionals; 3) put together the best file for your situation.

**POSSIBLE LEVELS FOR SELECTED ATTRIBUTES.** The values we selected for the five attributes we assigned to the renovation scenario presented to participants are summarised in Table 1

**Table 1: Selected Attributes × Levels in the choice experiment**

Attribute	Partial Works	Full Renovation
<b>Cost (€)</b>	3,500 - 9,000 - 12,600 - 18,000	19,000 - 26,000 - 35,000 - 46,000
<b>Energy savings</b>	3% - 6% - 15%	40% - 55% - 75%
<b>Comfort</b>	1/5 - 2.5/5 - 4.5/5	1/5 - 2.5/5 - 4.5/5
<b>Financing Scheme</b>	Yes - No	Yes - No
<b>OSS</b>	Yes - No	Yes - No

**Note:** The energy savings generated by the renovation are expressed as a percentage of their current bill. The level of comfort provided by the renovation is rated on a scale of 1 to 5, but presented in the form of stars (see Figure 1). Depending on the group the “Financing Scheme” corresponds either to Third-Party Scheme or to “Energy Efficient Mortgage”. OSS stands for One-Stop-Shop operator.

### 2.1.2 Design of the experiment

As previously noted, to isolate the effect of each financing scheme and minimize potential confusion among participants, we opted to split the sample into two groups. Upon entering the survey,

<sup>11</sup>These schemes are known as *Prêt Avance Renovation* (PAR and PAR+).

participants were randomly assigned to one of two subsamples: one exposed to the Third-Party Scheme (TPS), and the other to the Energy Efficient Mortgage scheme (EEM). This design choice aimed to ensure a clearer understanding of each financing mechanism without requiring participants to compare the two directly.

Before the discrete choice experiment began, each participant was shown a short explanatory text introducing the core principles of the assigned financing scheme (see boxes in the previous subsection). As illustrated in Figure 1, each retrofit alternative was presented as either subsidized or not, depending on whether the scheme applied. Importantly, the experiment did not follow a two-step logic where participants would first select a retrofit option and then choose a financing plan. Instead, the financing scheme was embedded within the attributes of the choice alternatives from the outset. To ensure that participants understood the task and the attributes involved, we included a warm-up choice set at the beginning of the experiment. After making their initial selection, participants were shown a brief summary of all attribute values for each alternative and were asked whether the summary aligned with the choice they had just made. This step helped verify their comprehension and familiarized them with the structure of the task before proceeding to the actual choice sets.

We presented each participant with 12 consecutive choice tasks. This number was chosen arbitrarily to maximize participants concentration while providing enough variation options given the number of attribute-level combinations. To ensure adequate variation and efficient estimation of individual attribute effects, we implemented a D-efficient design<sup>12</sup>, relying on prior assumptions about the functional form of participants' utility, as discussed in Section 2.3. Especially, the generation of such designs require priors on coefficients. In line with the literature, we hypothesized a positive sign for energy savings, the increase in comfort and both finance schemes and the OSS, and a negative sign for the cost of retrofits. In order to avoid systematic learning bias, each participants was presented the choice tasks in a random order, and each alternative within a choice task were presented in a random order (except the status quo option).

Each choice task included two retrofit alternatives and a third "status quo" option to opt out (as presented in Figure 1). This latter alternative served to anchor the task in realism by ensuring that each set included a feasible and familiar option. Its presence helped prevent participants from feeling forced into selecting an unattractive option, which could otherwise distort their reported preferences

<sup>12</sup>Generated with NGENE. "*Ngene is software for generating experimental designs that are used in stated choice experiments for the purpose of estimating choice models, particularly of the logit type.*" (see [Ngene 1.4 USER MANUAL & REFERENCE GUIDE The Cutting Edge in Experimental Design](#)).

and reduce the external validity of the results. More broadly, it allowed the experiment to reflect real-world decision-making situations, where doing nothing is always a possible course of action.

**Figure 1: Choice card example**

	Pack A	Pack B	None
Cost	€9,000	€35,000	
Energy savings	6%	40%	
Comfort	☆☆☆☆☆	☆☆☆☆☆	
Financing Scheme	Yes	Yes	
OSS	Yes	No	
Choice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Note:** Faced with this choice, participants can opt for minor renovation (Pack A), major renovation (Pack B) or no renovation, opting out (None). In this example, both renovation options benefit from the financing Scheme (Third-Party Scheme or Energy Efficient Mortgage depending on the group of participants). If the respondent chooses Pack A, they benefit from the One-Stop-Shop (OSS) operator unlike Pack B.

## 2.2 Participants characteristics

Statistics on participants are provided in Appendix C. The representativeness of our specific subsample of owner-occupiers of detached houses is verified using data from the 2023 wave of the Statistics on Resources and Living Conditions survey.<sup>13</sup> We observe slight overrepresentation of large houses and a shift towards upper incomes and higher ages.

Over half of participants do not know the EPC rating of their home (see Figure 2). This is hardly surprising, as these energy performance certificates (EPCs) or ‘energy performance diagnostics’ (EPDs) are only mandatory when selling a property or building (since 2006), when signing a rental contract for a property or residential building (since 2007), and for new buildings. Table 2 shows the distribution of participants’ homes by type of heating. Thus, 40.2% (33.3% respectively) of participants’ homes are heated by electricity (natural gas respectively).

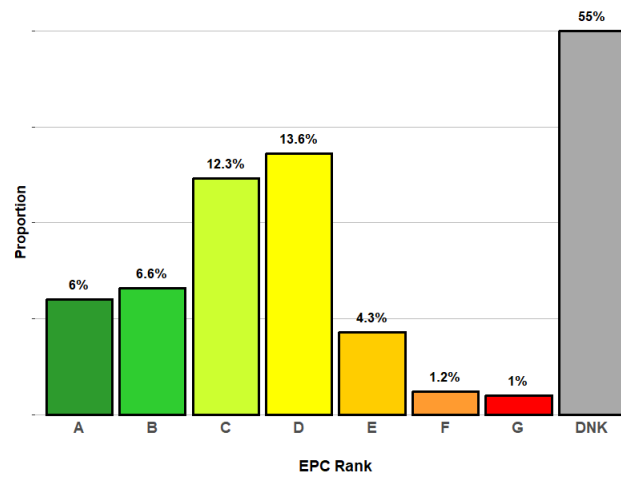
**Table 2: Heating type**

Heating type	Frequency
Wood	0.166
Electricity	0.402
Fuel oil	0.058
Natural Gas	0.333
Hybrid	0.041

**Note:** 40.2% of participants heat their homes with electricity.

Participants appear to be closely engaged with home management, particularly regarding

<sup>13</sup>Source of the Statistics on Resources and Living Conditions survey: see footnote 5 for reference.

**Figure 2: Energy Performance Certificate**

**Note:** 55% of participants do not know the EPC rating of their home.

energy retrofits, as suggested by their responses summarized in Table 4. A large majority report having already undertaken retrofit work and express general satisfaction with the outcome. We did not ask participants to specify the source of this satisfaction, whether it stemmed from energy savings, improved comfort, or other factors, as we wanted to avoid cognitive overload. As such, satisfaction likely reflects a broader set of dimensions, including interactions with contractors, respect of deadlines, or overall project delivery, and other factors not specific to energy efficiency. To indirectly assess the effectiveness of past renovations, we asked whether participants believed further retrofit work was still needed. A significant share answered affirmatively, which aligns with the proportion of participants reporting issues such as cold and humidity during winter months. This suggests that many dwellings in the sample still experience thermal inefficiencies. Moreover, no significant difference can be seen in the feeling of cold and humidity, as can be seen in Table 3.

**Table 3: Feeling in the house, by previous work underwent**

Did previous retrofit work	Yes (66%)	No (34%)
Does feel cold	0.46	0.45
Does feel humidity	0.28	0.27

Importantly, a substantial number of participants also reported planning further renovations, which we interpret as a positive sign. It indicates that our sample is not only experienced with the retrofit process but also engaged with ongoing improvements. This impression is reinforced by the relatively high awareness of existing subsidy programs reported by participants, as shown in Appendix D. Overall, we believe this sample is well-informed and appropriately suited to the choice

experiment, whose design aimed to reflect realistic decision-making conditions in the French retrofit landscape.

**Table 4: General feeling in the house and previous experience**

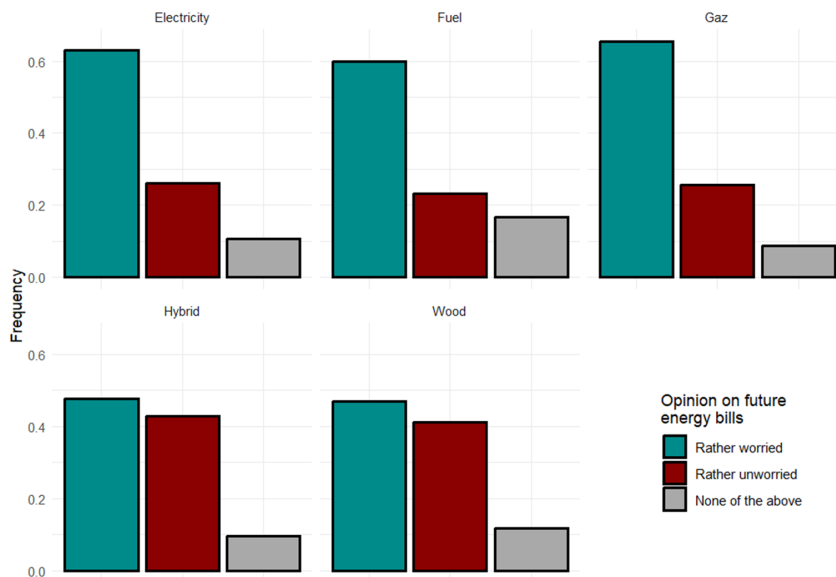
Question	Frequency
Feeling of cold	0.46
Feeling of humidity	0.28
Thinks energy prices will rise	0.89
Worried about future energy bills	0.60
Already underwent retrofits	0.66
↳ <i>Other work needed</i>	0.58*
↳ <i>Plans on doing them</i>	0.75*
Did not underwent retrofits	0.34
↳ <i>Plans to undergo first retrofits</i>	0.28*
Plans to sell ...	
<i>Within 5 years</i>	0.08
<i>Within 10 years</i>	0.13
<i>Does not plan to sell</i>	0.67
<i>Does not know</i>	0.11

\*: Frequencies are conditional to the above frequency, because questions were asked to a subset of participants, depending on previous question.

A large majority of participants (89%) reported expecting energy prices to rise in the future. However, a smaller share expressed concern about the impact on their own energy bills (see Figure 3). This apparent discrepancy is not surprising, as a significant portion of the sample, among those who reported knowing their Energy Performance Certificate (EPC) rating, live in relatively energy-efficient homes. In addition, upper incomes are over-represented as seen in Table 13. This likely mitigates their perceived vulnerability to future price increases. It should be noted that more than half of participants who use electricity, natural gas or fuel oil for heating are rather worried about future energy bills.

A majority of participants (67%) indicated that they do not plan to sell their dwelling in the near future. This information is relevant for interpreting preferences within the choice experiment, especially for the half of the sample exposed to the mortgage-based financing scenario, in which repayment is triggered upon the sale of the property. For these participants, planning to stay in their home may make this option appear more financially advantageous, as repayment is deferred and they continue to benefit from energy savings in the meantime.

We measure individual risk aversion using a well-established choice list procedure adapted from [Holt and Laury \(2002\)](#). Participants completed this task after the discrete choice experiment (DCE), in order to maintain their focus on the main survey objective. To avoid respondent fatigue, particularly given the cognitive load of the preceding DCE, we opted for a simplified and widely used format based on a series of binary choices between a safer and a riskier monetary payoff (see

**Figure 3: Opinion on future energy bills, by energy source**

**Note:** The graphs below show participants' opinions regarding their future energy bills based on the energy they use to heat their homes. More than 60% of participants who use gas to heat their homes (top right graph) are rather worried about their future bills.

Appendix B). Risk aversion levels are categorized based on the point at which participants switch from choosing the less risky option to the riskier one, which offers a higher potential payoff. This switching point allows us to infer a coarse but meaningful measure of each participant's attitude toward risk, which can later be used to explore heterogeneity in preferences for retrofit options.

Our results show that the majority of participants display risk-averse behavior in the monetary context of the experiment. Only a small fraction opted for the riskier payoff early in the sequence. Based on participants' switching points, we construct four discrete categories of risk aversion, as detailed in Table 5. In the subsequent analysis (see Section 3), we use these risk aversion categories as control variables. For modeling purposes, we also define a pseudo-continuous scale ranging from 0 to 1, where 1 corresponds to the most risk-averse individuals and 0 to the most risk-tolerant. This allows us to flexibly account for heterogeneity in risk preferences when estimating choice behavior in the discrete choice experiment.

### 2.3 A multinomial logit model (ML) to assess participants' preferences

We use a Multinomial Logit model (ML) to assess participants preferences towards energy retrofit work that have attributes described in sub-section 2.1. To adequately design the DCE, we used prior

**Table 5: Participants risk aversion**

	Frequency
Risk averse	0.28
Moderately averse	0.61
Risky	0.08
Very risky	0.02

values extracted from the literature for coefficients related to known attributes as described above in Section 2.1.2. Theoretical foundations come from the Random Utility Theory (McFadden (1972)), where participants make the choice that maximize their utility.

Let us consider a population of  $N$  participants. Each one of them is facing a set  $J$  of exclusive choices. An individual  $n \in \{1, 2, \dots, N\}$  that faces the choice  $j \in \{1, 2, \dots, J\}$  has an utility defined by

$$U_{n,j} = V_{n,j} + \epsilon_{n,j}, \quad (1)$$

where the first part being deterministic. Let us now consider a finite set of alternatives  $I$  included in  $J$ . Participants' choice in this finite set is defined as  $i$  if and only if

$$\forall i \neq i' \in I, U_{n,i} > U_{n,i'}. \quad (2)$$

Because participants' utility is not observable contrary to their choice, we can define the probability  $P_{n,i}$  to choose alternative  $i$  in the finite set  $I$  as

$$\mathbb{P}_{n,i} = \mathbb{P}\{U_{n,i} > U_{n,i'}, \forall i' \in I\} \quad (3)$$

$$= \mathbb{P}\{\epsilon_{n,i'} - \epsilon_{n,i} < V_{n,i} - V_{n,i'}, \forall i' \in I\}. \quad (4)$$

In order to further estimate an econometric choice model based on this probability, we need to make assumptions on the deterministic part  $V_{n,j}$ . We assume that  $V_{n,j} = \beta'_n X_j$  is a linear function of the  $M$  observable attributes in the design and an alternative specific constant, namely  $X_j = (ASC_j, X_{j,1}, \dots, X_{j,M})$ , parametrized by a vector  $\beta_n$ . The alternative specific constant is a dummy whose value is 1 in the case the default (status quo) option is selected, and 0 if not. Therefore, the probability of choosing alternative  $i$  writes

$$\mathbb{P}_{n,i} = \mathbb{P}\{\epsilon_{n,i'} - \epsilon_{n,i} < \beta'_n (X_i - X_{i'})\}. \quad (5)$$

Estimation requires assumptions on the distribution of the error terms  $\epsilon_{n,j}$ . In the standard Conditional Logit (MNL), they are assumed Independent and Identically Distributed (i.i.d.) type-I extreme value, which yields the closed-form probability

$$\mathbb{P}_{n,i} = \frac{\exp(\beta'_n X_i)}{\sum_{i' \in I} \exp(\beta'_n X_{i'})}. \quad (6)$$

This implies the Independence of Irrelevant Alternatives (IIA) property, which may be restrictive in applied settings. To account for unobserved heterogeneity, the Random Parameters Logit (RPL) allows  $\beta_n$  to vary across individuals of a continuum  $\theta$  according to a distribution  $f(\beta | \theta)$ :

$$\mathbb{P}_{n,i} = \int \frac{\exp(\beta' X_i)}{\sum_{i' \in I} \exp(\beta' X_{i'})} f(\beta | \theta) d\beta. \quad (7)$$

This relaxation captures random taste variation. Usual assumptions over the distribution of parameters  $\beta$  can be normal, log-normal, etc., so they require priors from the literature. The estimation is then made by maximum simulated likelihood. The Mixed Multinomial Logit (MMNL) further generalizes this approach by combining random coefficients with flexible error structures, thereby overcoming the IIA property and allowing for correlation across alternatives and choice situations (Train (2009)). In the empirical section, we rely on these specifications to assess robustness with respect to heterogeneity and substitution patterns.

In the subsequent analysis, we estimate the willingness to pay (WTP) as a welfare-consistent measure that expresses the implicit monetary value households assign to non-monetary retrofit attributes. Formally, the WTP for attribute  $m$  is given by

$$WTP_m = -\frac{\beta_m}{\beta_{Price}}. \quad (8)$$

This formulation highlights that the estimated WTP reflects the compensating variation associated with changes in attribute  $m$ , expressed in monetary terms. Methodologically, this approach relies on the assumption that the price coefficient is constant across participants. From a policy perspective, WTP provides a direct measure of the trade-offs that households are willing to make between retrofit characteristics and their associated costs.

### **3. RESULTS**

We begin by presenting the main effects estimated from a standard Multinomial Logit (MNL) model, as specified in Section 2.3. This baseline specification captures the average preferences across each group, meaning we estimated the model parameters for each group separately. In a second step, we explore potential sources of heterogeneity by introducing interaction terms and segmenting the sample based on respondent characteristics collected in the preliminary survey. This two-stage approach allows us to provide richer insights into household decision-making processes regarding energy retrofit scenarios.

#### **3.1 Main effects**

Results for the main effects of the Multinomial Logit (MNL) model are reported in Table 6. The first row presents the Alternative-Specific Constant (ASC), which is positive and statistically significant for the group exposed to the mortgage-based financing scheme. The ASC is a dummy variable equal to one when the alternative corresponds to the reference option (i.e., the status quo) and zero otherwise. It captures the baseline utility that respondents assign, on average, to maintaining their current situation rather than engaging in retrofit work. The positive and significant coefficient therefore indicates a general preference for the status quo over the proposed renovation alternatives, consistent with the idea that many households perceive retrofits as costly or uncertain relative to inaction. Given that the renovation options presented often substantial costs not always offset by equivalent energy savings, it was expected that participants would, on average, favor the status quo option. This intuition is confirmed by the data: across the 12 choice tasks, respondents selected the status quo alternative an average of 7.75 times, indicating a clear tendency to prefer inaction over engagement in retrofit projects. However, we observe a notable difference between the two experimental groups. In the group exposed to the third-party financing scheme, the ASC is not statistically different from zero, suggesting that this scheme may be perceived as more attractive or acceptable than the mortgage. This result is consistent with the idea that third-party financing, unlike the mortgage scheme, does not involve any form of ownership transfer or financial dispossession. Instead, it operates through a risk transfer mechanism, whereby the third party bears the responsibility of delivering sufficient energy savings to recover their investment. This likely improves the perceived credibility and convenience of the offer for many participants.

**Table 6: Main effects for Multinomial logit**

	Third party (1)		Mortgage (2)	
ASC	0.286***	(0.110)	0.319***	(0.112)
Cost	-0.024***	(0.003)	-0.032***	(0.004)
Savings	0.016***	(0.002)	0.017***	(0.002)
Comfort	0.046***	(0.017)	0.061***	(0.017)
OSS	0.083	(0.058)	0.138**	(0.061)
Finance scheme	0.221***	(0.055)	0.128**	(0.058)
ASC × Risk aversion	1.545***	(0.253)	1.407***	(0.221)
Observations	3,084		3,072	
Log Likelihood	-3,064.234		-2,918.583	

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Note:** Values are reported in the following format: point estimates first, followed by standard errors in parentheses. ASC stands for “Alternative-Specific Constant” measures the status quo bias. Thus, on average, participants belonging to this group where the mortgage was offered prefer not to renovate their homes. Cost is expressed in thousands of euros, while energy savings are given as a percentage of the household’s energy bill. Comfort is measured on a five-star scale; the corresponding coefficient therefore reflects the marginal effect of an additional star on perceived comfort. Both the OSS operator and the financing scheme are included as dummy variables.

Unsurprisingly, and consistent with previous findings in the literature ([Bakaloglou and Belaid, 2022](#); [Galassi and Madlener, 2017](#); [Fanghella et al., 2023](#)), costs are negatively associated with the likelihood of choosing a retrofit alternative. Conversely, both expected energy savings and perceived comfort improvements have a significant and positive effect on the probability of selecting a retrofit scenario. These results align with the responses collected in the preliminary questionnaire and highlight that individuals demonstrate a certain degree of rationality. A large share of participants reported experiencing cold and humidity in their homes, as well as expressing concerns about future increases in energy bills. In this context, energy savings and enhanced comfort appear to directly address two core issues, financial strain and physical discomfort, which are salient for many participants. In particular, the estimated effects of these two attributes are of comparable magnitude across both experimental groups, suggesting broadly shared preferences in this regard.

The results regarding both financing schemes and the OSS operator provide valuable insights. Participants appear strongly influenced by the presence of a financing options, with the effect being particularly pronounced in the case of the Third-Party Scheme (TPS). Interestingly, the OSS operator, which is not significant in the TPS, gains greater relevance in the mortgage scheme context. This pattern suggests that when households perceive themselves as bearing more of the risks associated with retrofits, as is the case under a mortgage arrangement, they are more likely to value institutional

support that reduces these risks, such as guidance in selecting reliable professionals, ensuring quality work, and managing administrative procedures. By contrast, in the TPS scenario, such concerns are largely transferred to the third party itself, which may explain why the OSS plays a less prominent role. Nevertheless, it gives insights on how well participants understood the financing schemes and their understanding of risk transfers. This is interesting from a public policy perspective, but also from an analytical point of view, as it is what happens when risks for households are reduced and financial constraints (the remaining cost) are eased.

Finally, the coefficient associated with risk aversion suggests that in both groups, risk averse individuals tend to opt-out of retrofit scenarios.

### **3.2 Interacted effects**

Our experiment allows us to determine whether the funding schemes studied encourage households to opt for more expensive projects than they would without these schemes. Thus, by examining interactions in Table 7, we find that, particularly in the case of Third-Party Scheme, the presence of a finance plan tends to mitigate the negative effect of upfront costs, meaning that the loss of utility attributed to costs is lower in the presence of a finance scheme. The coefficient associated with *Finance Scheme (Third-Party Scheme) × Cost* is positive and significant. Participants seem to be thinking about costlier projects when a finance plan is available. Once again, risk mitigation and transfer towards a third party might be playing a role in diminishing aversion to high costs in ensuring quality of retrofits. Therefore, such funding programs could help increasing retrofit rates.

### **3.3 Individual characteristics**

Individual characteristics influence the decision to renovate one's home, as highlighted by the results presented in Table 8. These individual characteristics are interacted with the alternative-specific constant (ASC), which equals 1 when the status quo option is chosen. A positive coefficient on such an interaction indicates that the corresponding characteristic increases the likelihood of selecting the status quo alternative, suggesting that this trait is a significant determinant of opting against retrofit adoption.

While most attribute effects remain stable or only slightly adjusted after taking heterogeneity into account (comparison of the results in Tables 6 and 8), comfort stands out as the most sensitive attribute. Once individual controls are included, its estimated effect nearly doubles under both

**Table 7: Interaction effects: *Finance Scheme* × *Cost***

	Third-Party (1)		Mortgage (2)	
ASC	0.149	(0.136)	0.261*	(0.139)
Cost	-0.030***	(0.005)	-0.035***	(0.005)
Savings	0.016***	(0.002)	0.018***	(0.002)
Rating	0.046***	(0.017)	0.061***	(0.017)
OSS	0.077	(0.058)	0.134**	(0.061)
Finance scheme	-0.001	(0.142)	0.034	(0.147)
Finance scheme × Cost	0.010*	(0.006)	0.004	(0.006)
ASC × Risk aversion	1.547***	(0.253)	1.406***	(0.221)
Observations	3,084		3,072	
Log Likelihood	-3,062.657		-2,918.333	

\*p&lt;0.1; \*\*p&lt;0.05; \*\*\*p&lt;0.01

**Note:** Values are reported in the following format: point estimates first, followed by standard errors in parentheses. Cost is expressed in thousands of euros, while energy savings are given as a percentage of the household's energy bill. Comfort is measured on a five-star scale; the corresponding coefficient therefore reflects the marginal effect of an additional star on perceived comfort. Both the OSS operator and the financing scheme are included as dummy variables. Finally, note that risk aversion is interacted with each alternative.

financing schemes. This pattern is not unexpected, as comfort is plausibly the attribute most closely linked to individual heterogeneity. Unlike cost or energy savings, comfort lacks a universally objective definition in the housing context. Given that our experiment was explicitly framed around retrofits, participants were likely prepared to interpret the attribute in terms of thermal comfort, which was emphasized as a primary benefit of renovation. This interpretation is consistent with [Berto et al. \(2023\)](#), who show that thermal comfort is generally valued more highly than other dimensions such as acoustic, visual, or air quality. Nevertheless, it is also plausible that participants interpreted the attribute in a broader aspect, treating it as a composite indicator that encompasses multiple aspects of well-being, including aesthetic improvements or general dwelling quality. Results suggest that comfort is subject to heterogeneity in preferences, which we confirm later in Appendix 3.5 running a Mixed Multinomial Logit model (MMNL) with the assumption that coefficients follow a standard distribution. Controlling for socio-demographic and household characteristics helps disentangle heterogeneity, yielding more reliable estimates. More generally, the results highlight the need to account for systematic differences in how attributes are valued across participants, as socio-economic profiles appear to shape not only perceptions of comfort but also preferences toward financing mechanisms and institutional support.

Like in the main effects model, risk aversion is strong determinant of participants opting out.

**Table 8: Results for the MNL model with individual-specific characteristics**

	Third-Party (1)		Mortgage (2)	
ASC	-0.516	(0.473)	0.791	(0.567)
Cost	-0.025***	(0.003)	-0.033***	(0.004)
Savings	0.016***	(0.002)	0.018***	(0.002)
Comfort	0.137**	(0.065)	0.033	(0.066)
OSS	0.083	(0.058)	0.140**	(0.061)
Finance scheme	0.220***	(0.055)	0.129**	(0.058)
<b>Interactions with ASC<sup>#</sup></b>				
Risk aversion	1.096***	(0.266)	0.986***	(0.236)
Age	0.016***	(0.004)	0.018***	(0.004)
Woman	-0.251***	(0.080)	0.299***	(0.081)
Income class				
1251–2120	0.249	(0.301)	-1.194***	(0.432)
2121–2920	0.182	(0.291)	-1.355***	(0.419)
2921–4120	0.162	(0.286)	-1.555***	(0.419)
4121–5267	-0.016	(0.290)	-1.374***	(0.423)
> 5267	0.003	(0.292)	-1.243***	(0.427)
Feels cold in the dwelling	0.705**	(0.288)	0.004	(0.290)
Holds a credit	-0.138	(0.098)	-0.218**	(0.093)
Is worried about future bills	-0.224***	(0.083)	0.166**	(0.082)
Has previously retrofitted	-0.714***	(0.088)	-0.454***	(0.087)
Observations	3,084		3,072	
Log Likelihood	-2,996.000		-2,865.856	

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Note:** All terms below (<sup>#</sup>) are interacted with the Alternative Specific Constant dummy ASC. The reference category for *Income class* is "Less than 1250". Coefficients express the influence of individuals specific variable with respect to their reference category of choosing the status quo over a retrofit scenario.

In the third-party group, women are more inclined to maintain the status quo than men. The result is the opposite for the group where a mortgage is offered. Age has a similar impact on the probability of retrofitting for both groups, with older people opting out more often. This may come from the fact that our repayment mechanisms do not mention precise repayment durations. We might have let participants with uncertainty about how the repayment ends in special case, like succession or selling of the dwelling in one case or another.

The results and the coefficient associated to  $ASC \times Holds\ a\ credit$  suggest that financing schemes reduce barriers to undertaking retrofits, insofar as holding an existing mortgage or credit does not appear to deter households in either group. On the contrary, by alleviating upfront financial constraints and introducing innovative repayment mechanisms, these schemes may enable credit-constrained households to invest in retrofits. In the framework of third-party financing, repayment is effectively guaranteed by the quality and performance of the renovation itself, rather than by

household income or financial standing. As such, the financing arrangements are more closely tied to the dwelling's efficiency as an asset than to the specific characteristics of its occupants. In addition, efficient energy renovation can also help to increase the property value of the home.

The coefficient on the interaction term  $ASC \times Worried\ about\ future\ bill$  indicates that, under both financing schemes, there is a strong association between concern over future energy price increases and the likelihood of opting for a retrofit alternative. This finding suggests that for our participants, expected financial savings represent a central motivation of renovation decisions. This result is not surprising given the timing of the survey, conducted in mid-2024, when energy prices in France were experiencing substantial increases. That year, natural gas prices for households rose by 13%, and electricity prices by 18% ([Service des données et études statistiques \(SDES\), 2025a](#)). Moreover, the average household price of natural gas in France was 11% higher than in the rest of the European Union ([Service des données et études statistiques \(SDES\), 2025b](#)). This broader context likely shaped participants' expectations regarding future energy prices and, consequently, their perceptions of the benefits of retrofitting.

Having previously undertaken retrofit work appears to encourage respondents to opt for additional renovations. We argue that prior experience with retrofits, whether positive or negative, may have reinforced participants' awareness of their dwelling's potential improvements rather than fully satisfying their expectations. Moreover, many households may view earlier renovations as a starting point for a broader, ongoing process, since a majority (58%, as shown in Table 4) reported that further retrofit work was still needed. In this context, both third-party financing and mortgage-based schemes could play a decisive role by alleviating financial constraints, thereby allowing households to focus on achieving the desired performance level for their homes. In the case of the third-party scheme, in particular, the achievable performance directly determines the repayment capacity, further aligning incentives between households and financiers.

### **3.4 Willingness to pay**

We compute the average willingness to pay (WTP) for each attribute in our sample of respondents. Average values are determined using equation (8), and we use the method introduced by [Krinsky and Robb \(1986\)](#), with a number of 1000 draws to compute standard errors and the confidence intervals. We take coefficients from the main effects specification that is defined in Table 6.

Results for the willingness to pay (WTP) estimates are presented in Table 9, separately for

both financing schemes. On average, participants are willing to pay €555 per additional 1% reduction in their energy bill under the Third-Party Scheme (TPS), and €501 under the mortgage-based scheme. This implies that, for a retrofit leading to a 75% reduction in energy expenses, respondents would be willing to invest approximately €41,625 and €37,575, respectively. The DREAL Grand Est estimated in 2023 that retrofits achieving an average 50% energy saving cost around €27,000, based on observed market data.<sup>14</sup> These figures suggest that participants' stated preferences reflect a relatively realistic understanding of renovation costs and expected performance.

**Table 9: Willingness to pay**  
**(a) Finance scheme: Third-Party**

	Savings	Comfort	OSS	Third-Party
Average WTP	555	1,842	Non significatif	8,767
CI (95%)	413-738	558-3,352	–	4,292-14,450

**(b) Finance scheme: Mortgage**

	Savings	Comfort	OSS	Mortgage
Average WTP	501	1,868	4,264	3,869
CI (95%)	391-640	820-3,003	570-8,225	372-7,422

**Note:** Confidence intervals (95%) are computed following the Krinsky and Robb procedure (Krinsky and Robb (1986)). WTP for savings is in € per %, comfort is in € per star. WTP for OSS and finance scheme is the amount participants are ready to pay for the inclusion of such operators.

The estimated WTP for comfort improvements is also comparable across both groups, with respondents willing to pay on average €1,850 for an additional star on the five-point comfort scale. Finally, while the inclusion of a third-party financing scheme is highly valued, participants show greater reluctance toward the mortgage-based option, consistent with the patterns discussed earlier.

### 3.5 Heterogeneity in preferences

Standard errors in Table 10 are mostly insignificant, except for the comfort attribute. This limited variability suggests that, within our sample of owner-occupiers, preferences are relatively homogeneous. It seems to be particularly true regarding financial aspects of retrofit decisions. This homogeneity is plausible given that all respondents are owner occupiers of their housing, and probably share a similar relationship to their dwelling, both as a place of residence and a financial asset. By contrast, studies that include tenants often reveal substantial preference heterogeneity between owners and renters (see Caplan et al. (2021)), with homeowners typically displaying a markedly higher willingness to pay for

<sup>14</sup>The DREAL Grand Est is the Regional Directorate for Environment, Planning and Housing for the Grand Est region in France.

housing amenities.

**Table 10: Main effects, results of Mixed MNL model**

	Third-Party (1)		Mortgage (2)	
ASC	0.136	(0.148)	0.312***	(0.117)
Cost	-0.029***	(0.005)	-0.033***	(0.004)
Savings	0.018***	(0.002)	0.018***	(0.002)
Comfort	0.060***	(0.022)	0.063***	(0.018)
OSS	0.086	(0.063)	0.129*	(0.069)
Finance Scheme	0.226***	(0.059)	0.130**	(0.061)
ASC× Risk aversion	1.984***	(0.388)	1.470***	(0.240)
Standard errors				
ASC	1.150***	(0.352)	0.110	(0.243)
Cost	0.017*	(0.009)	0.0001	(0.009)
Savings	0.002	(0.005)	0.001	(0.005)
Comfort	0.131*	(0.074)	0.179***	(0.056)
OSS	-0.133	(0.282)	0.210	(0.283)
Finance plan	0.057	(0.270)	-0.084	(0.275)
Observations	3,084		3,072	
Log Likelihood	-3,062.364		-2,915.898	

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Note:** We make the assumption that every coefficient is normally distributed.

The lack of observed heterogeneity in financial preferences may also be inherited from the nature of the financing schemes presented in the experiment. These mechanisms were designed to remove conventional financial barriers, such as upfront payments or income-based eligibility conditions, and to rely instead on automatic repayment mechanisms. In the case of the Third-Party Scheme, repayment is entirely performance-based, which further detaches the household's financial situation from the retrofit decision. Under the mortgage scheme, the property value plays a more central role, and some degree of perceived inequality may persist: households with lower income, that may be owning lower-quality dwellings might anticipate a smaller capital gain from renovation, potentially influencing their willingness to engage in retrofit projects.

Table 11 provides insights into the sources of heterogeneity in comfort valuation. Interestingly, gender effects appear mixed across groups: being a woman has a mitigating influence on the perceived importance of comfort in some cases but not in others. Similarly, the impact of having previously undertaken retrofits is somewhat puzzling, as it seems to reduce the marginal effect of comfort on the probability of choosing a renovation option. A plausible explanation lies in unobserved heterogeneity in comfort perception. Prior experience with energy renovation does not necessarily

translate into better information or clearer preferences, since we cannot observe whether previous works were successful, aligned with expectations, or met the intended comfort goals. As shown later in Appendix E.2, income does not appear to play a significant role in explaining comfort-related heterogeneity.

**Table 11: Interactions with *comfort***

	Third-Party (1)		Mortgage (2)	
ASC	-0.535	(0.352)	-0.651*	(0.346)
Cost	-0.025***	(0.003)	-0.033***	(0.004)
Savings	0.016***	(0.002)	0.018***	(0.002)
<b>Comfort</b>	0.163*	(0.093)	0.049	(0.098)
Age	0.0001	(0.001)	-0.001	(0.001)
Woman	-0.027	(0.028)	0.063**	(0.029)
Feels cold	-0.003	(0.045)	-0.017	(0.048)
Previously retrofitted	-0.125***	(0.031)	0.030	(0.031)
OSS	0.086	(0.058)	0.139**	(0.061)
Finance scheme	0.220***	(0.055)	0.130**	(0.058)
<b>Interactions with ASC<sup>#</sup></b>				
Risk aversion	0.934***	(0.266)	1.162***	(0.229)
Age	0.018***	(0.004)	0.021***	(0.004)
Woman	-0.217***	(0.078)	0.330***	(0.079)
Feels cold	0.591**	(0.293)	-0.014	(0.297)
Holds a credit	-0.143	(0.097)	-0.183**	(0.092)
Previously retrofitted	-0.791***	(0.088)	-0.424***	(0.085)
Observations	3,084		3,072	
Log Likelihood	-2,986.136		-2,866.409	

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Note:** All terms below (<sup>#</sup>) are interacted with the Alternative Specific Constant dummy ASC.

More broadly, comfort should not be interpreted as a secondary benefit of retrofitting, but rather as a central policy lever. In line with [Bakaloglou and Belaid \(2022\)](#), who define comfort more narrowly as “increased indoor temperature,” our findings suggest that comfort improvements remain a key determinant of renovation choices. Policies emphasizing tangible comfort gains rather than abstract energy savings may thus prove more effective in encouraging households to engage in energy retrofits.

#### 4. POLICY TAKEAWAYS

Our experimental results indicate that participants’ retrofit choices are positively influenced by the introduction of both proposed financing mechanisms. From a theoretical standpoint, these two instruments provide concrete responses to key failures in the energy renovation market. The third-party

financing (TPF) scheme operates along two fundamental dimensions: it alleviates households' upfront financial constraints while simultaneously transferring the risk of poor workmanship to a professional intermediary. Participants appear to have internalized these features, as reflected in their strong revealed preference for this option. By contrast, the mortgage-based mechanism exerts a more nuanced influence on preferences. In this case, respondents assign greater value to the presence of a one-stop-shop (OSS) operator, whose coordinating role, ensuring contractor reliability and facilitating access to subsidies, appears to mitigate the perceived risks associated with renovation management.

From a policy perspective, these findings directly address one of the most persistent challenges in the energy retrofit sector: guaranteeing the quality of renovation work. In France, successive public programmes have introduced "€0 remainder-to-pay" mechanisms, primarily targeted at low-income households through extensive subsidies. While well-intentioned, these schemes have often been associated with fraudulent practices, substandard workmanship, and moral hazard among contractors. The combination of generous subsidies and insufficient oversight created fertile ground for opportunistic behavior. Consequently, households are increasingly likely to demand credible, verifiable guarantees of quality before committing to retrofit projects.

This challenge has prompted a series of regulatory reforms aimed at strengthening monitoring and accountability mechanisms. The Directorate-General for Competition, Consumer Affairs, and Fraud Control (DGCCRF) now holds the authority to suspend or revoke the "RGE" (Reconnu Garant de l'Environnement)<sup>15</sup> certification, a prerequisite for firms undertaking publicly subsidized works. Yet, certification alone remains an imperfect signal of quality. Although the French legal framework includes a ten-year warranty for renovation and construction works, enforcement typically requires lengthy and complex administrative or legal procedures that many households lack the capacity to pursue.

#### **4.1 Feasibility of Third-Party Schemes**

While the proposed financing mechanisms relieve households of much of the financial burden of renovation by alleviating selection criteria and remainder-to-pay, they also raise important questions about feasibility and scalability in the French market context. A third-party intermediary that centralizes project design, verification, and financing could, in theory, better assess technical risks and achieve economies of scale in transaction costs. However, such entities are simultaneously exposed

<sup>15</sup>"Reconnu Garant de l'Environnement" translated as *Recognised as an environmental guarantor*.

to credit default and performance risk, which may arise from household behavior. For instance, a renovated household may alter its consumption patterns, generating a rebound effect that reduces realized energy savings relative to projections.

In France, several regional public operators already embody this model, such as Île-de-France Énergies, Oktave (Grand Est), and Pass Rénovation (Hauts-de-France). According to [Gracia \(2025\)](#), in 2023, these entities collectively managed over 18,000 audits, 6,160 renovation projects, and approximately 1,300 financed operations, corresponding to a total investment volume of about €40 million. Although these figures remain modest at the national scale, they illustrate a viable prototype that could be expanded through standardization and the implementation of risk-sharing mechanisms. Empirical evaluations conducted by the French Ministry for Energy Transition (2024) indicate that third-party funding (TPF) operators simplify the renovation process and significantly increase completion rates for comprehensive retrofits, which aligns with our experimental findings on participants' demand for insurance and risk protection.

Nonetheless, these operators face significant capitalization constraints. Because they assume part of the repayment risk, their ability to scale depends critically on access to guarantees and refinancing instruments. The French Fonds de Garantie pour la Rénovation Énergétique (FGRE), was established precisely to mitigate these financial frictions. These public funds cover up to 75% of potential losses on renovation loans and 50% for condominiums.<sup>16</sup> The guarantees act as a portfolio insurance mechanism, enabling intermediaries to mutualize household-level risk and to reduce the cost of capital.

Such guarantees also alleviate lenders' concerns about rebound effects: even if realized energy savings fall short of forecasts, financial exposure remains limited. This risk-sharing architecture encourages the participation of local banks and paves the way for the safety of green renovation portfolios. However, scaling up these schemes will require further standardization, in contractual templates, performance measurement, and data interoperability, to minimize transaction costs and facilitate refinancing.

International experience underscores the importance of consumer trust and administrative simplicity, which are central to the rationale for third-party financing. Excessive procedural complexity can undermine participation, which is precisely the issue currently facing French retrofit policies. The UK's "Green Deal" (2013–2015), conceptually close to the TPF model, failed to generate substantial

<sup>16</sup>see [ANIL](#).

demand due to cumbersome procedures, high interest rates, and widespread distrust ([National Audit Office \(UK\), 2016](#)). By contrast, France’s ongoing experiment with a centralized “Banque de la Rénovation” (FIDEO) seeks to overcome these barriers by providing pooled capital and refinancing capacities for local intermediaries ([ADEME, 2023](#)).

#### **4.2 Mortgage-based instruments**

The mortgage-based financing scheme addresses a different, yet equally structural, set of constraints in the home renovation market. Many asset-rich households remain reluctant to invest in energy retrofits because conventional loans tie repayment capacity to current income levels, which often serve as an eligibility condition. By contrast, mortgage-based instruments link repayment obligations to the value of the property itself, thereby allowing households to undertake renovation works without immediate budgetary pressure. Unlike the third-party scheme, where households do not directly perceive the financial gains from reduced energy bills, mortgage-based loans enable beneficiaries to retain the full benefit of energy savings throughout the repayment period.

France’s *Prêt Avance Mutation* (PAM) and its enhanced version, the *Prêt Avance Rénovation* (PAR+), represent the country’s main innovations in this category ([ONPE, 2024](#); [Service Public, 2025](#)). These instruments are secured by a first-rank mortgage and are repaid only upon sale or inheritance of the property. The PAR+ further includes a zero-interest-rate component and a partial public guarantee for low-income borrowers, thereby enabling immediate renovation investment without affecting short-term liquidity. The lender’s risk exposure is contained through the property’s collateral value and through public reinsurance mechanisms provided by the *Fonds de Garantie pour la Rénovation* (FGR)<sup>17</sup>. Nevertheless, access to these loans typically remains conditional on income or age thresholds, which limits their broader diffusion.

Linking repayment to property value rather than household income could also generate opportunities in the housing resale market. Under current policies restricting the rental of energy-inefficient dwellings, the supply of low-efficiency properties for sale is expected to rise sharply. In this context, mortgage-based renovation loans could facilitate the transfer of such assets to new owners willing to invest in retrofits. For landlords, these instruments offer a way to preserve or even enhance asset value, as energy-efficient (“green-labeled”) dwellings tend to sell at a price premium relative to inefficient ones ([Brounen and Kok, 2011](#)). Moreover, repayment upon sale reduces the temporal

<sup>17</sup>See [Official website of the FGR](#).

commitment associated with traditional loans, aligning well with short- or medium-term investment horizons. Similarly, the transfer of repayment obligations upon inheritance represents an avenue worth exploring in future policy design and research.

### **4.3 Cross-cutting policy takeaways**

Both recent policy developments and the structure of these financing mechanisms contribute to understanding how they could operate as components of a coherent and complementary renovation strategy. Similar to the multiplicity of subsidy instruments historically implemented in France to stimulate energy retrofits, a portfolio of financing tools could address the diverse constraints faced by different household segments. Third-party financing is particularly well suited for households with stable income but limited liquidity, while mortgage-backed loans better serve senior homeowners or those unwilling to increase debt service. Both schemes ensure by structure that simplification and consumer trust remain central. Still, ensuring a single point of contact and providing transparent information on expected energy savings may help reduce potential additional perceived risks for both households and financial intermediaries.

Public guarantee schemes such as FRGE, should not be viewed as peripheral instruments but as structural preconditions for market scaling. By mitigating lenders' concerns regarding credit defaults and rebound effects, they enable portfolio mutualization and facilitate the emergence of a viable and safe renovation finance market.

Finally, the large-scale deployment of these mechanisms calls for the development of a secondary market for green renovation finance. Aligning data and reporting frameworks with the European Energy Efficient Mortgage Initiative (EEMI) could facilitate securitization and the issuance of covered bonds backed by energy-efficient assets ([Energy Efficient Mortgage Initiative \(EEMI\), 2024](#)). Such financial integration would lower the cost of capital and attract institutional investors, ensuring long-term liquidity in the sector.

In sum, third-party financing and mortgage-backed instruments could together form the backbone of a scalable and inclusive renovation finance ecosystem, provided that risk-sharing mechanisms, transparency, and consumer protection remain at its core.

## 5. CONCLUSION

Our results indicate that, among our sample of owner-occupiers of individual houses, both third-party and mortgage-based financing mechanisms are generally well received. Moreover, these instruments appear to mitigate the negative effect of upfront costs, particularly in the case of the third-party scheme. The experimental inclusion of a one-stop-shop (OSS) operator, designed to reduce transaction costs and minimize risks associated with the selection of contractors, proved significant only in the mortgage group. This finding suggests that respondents exposed to the mortgage scheme were more sensitive to risk-reduction mechanisms related to retrofit implementation. Conversely, participants assigned to the third-party scheme seem to have internalized the notion of risk transfer inherent to that mechanism, and selected less often such an operator to internalize risk.

For most attributes, we detect limited heterogeneity in preferences, except in the case of comfort. We interpret this result as a reflection of both the simplicity of the comfort definition used in the experiment we designed and the relative homogeneity of owner-occupiers in their financial preferences regarding retrofit costs and benefits. Consequently, the only remaining source of unobserved heterogeneity likely resides in subjective dimensions, such as comfort perception. Interestingly, this heterogeneity cannot be explained by conventional household characteristics, such as income, age, or gender, suggesting that comfort preferences may depend on deeper behavioral or psychological factors that remain outside the scope of our model.

While our study focuses exclusively on owner-occupiers, which limits its external validity to other tenure types (notably landlord–tenant situations characterized by information asymmetry and split incentives), it nevertheless provides policy-relevant insights into the design of renovation financing instruments. Both funding schemes introduced here address some existing market failures (e.g. information asymmetry) while aligning well with the concept of opportunistic retrofitting, that is, undertaking renovations at key moments in a dwelling’s life cycle (e.g., sale, inheritance, or major refurbishment). These mechanisms contribute to a broader policy vision in which energy consumption reduction and renovation incentives are attached to the dwelling itself rather than to its current occupant.

Households are certainly responsible for their energy consumption, but they do not want to bear the entire financial and administrative burden of achieving national carbon mitigation objectives. Linking renovation repayment either to energy savings (as in third-party financing) or to asset value (as

in mortgage-based instruments), when combined with appropriate market infrastructure and regulatory support, could foster a faster and higher-quality diffusion of retrofits. In this respect, our findings support the idea that well-designed financial mechanisms can reconcile household decision-making constraints with the collective goals of the energy transition. Eventually, this retrofit process is more inclusive towards usually aggrieved households, whether they are income or asset poor, and it could help reduce fuel poverty.

Future research could extend this analysis by exploring behavioral mechanisms and contextual heterogeneity in greater depth. Examining how financing instruments perform across different tenure types, market conditions, and regional policy frameworks would provide a more comprehensive understanding of their scalability, external validity and long-term effectiveness within national and European renovation strategies.

**REFERENCES**

- ADEME. [Projet FIDEO : vers une banque de la rénovation énergétique](#), 2023. ADEME.
- D. W. Allen. What are transaction costs? *Rsch. in L. & Econ.*, 14:1, 1991.
- A. Bagaini, E. Croci, and T. Molteni. Boosting energy home renovation through innovative business models: ONE-STOP-SHOP solutions assessment. *Journal of Cleaner Production*, 331:129990, 2022.
- S. Bakaloglou and F. Belaid. The role of uncertainty in shaping individual preferences for residential energy renovation decisions. *The Energy Journal*, 43(4):127–158, 2022.
- S. Beggs, S. Cardell, and J. Hausman. Assessing the potential demand for electric cars. *Journal of econometrics*, 17(1):1–19, 1981.
- R. Berto, F. Tintinaglia, and P. Rosato. How much is the indoor comfort of a residential building worth? A discrete choice experiment. *Building and Environment*, 245:110911, 2023.
- P. Bertoldi, M. Economidou, V. Palermo, B. Boza-Kiss, and V. Todeschi. How to finance energy renovation of residential buildings: Review of current and emerging financing instruments in the EU. *Wiley Interdisciplinary Reviews: Energy and Environment*, 10(1):e384, 2021.
- E. Bertone, O. Sahin, R. A. Stewart, P. X. Zou, M. Alam, K. Hampson, and E. Blair. Role of financial mechanisms for accelerating the rate of water and energy efficiency retrofits in australian public buildings: Hybrid bayesian network and system dynamics modelling approach. *Applied Energy*, 210:409–419, 2018.
- D. Brounen and N. Kok. On the economics of energy labels in the housing market. *Journal of Environmental Economics and Management*, 62(2):166–179, 2011.
- A. J. Caplan, S. B. Akhundjanov, and K. Toll. Measuring heterogeneous preferences for residential amenities. *Regional Science and Urban Economics*, 87:103646, 2021.
- E. W. de Bekker-Grob, M. Ryan, and K. Gerard. Discrete choice experiments in health economics: a review of the literature. *Health economics*, 21(2):145–172, 2012.
- S. Ebrahimi-harehbaghi, Q. K. Qian, F. M. Meijer, and H. J. Visscher. Transaction costs as a barrier in the renovation decision-making process: A study of homeowners in the netherlands. *Energy and Buildings*, 215:109849, 2020.
- Energy Efficient Mortgage Initiative (EEMI). [European Energy Efficient Mortgage Initiative](#), 2024.
- V. Fanghella, M.-C. Guetlein, J. Schleich, and C. Sebi. Preferences on financing mechanisms for thermal retrofit measures in multi-owner buildings: A discrete choice experiment with landlords and owner-occupiers in france. *Resource and Energy Economics*, 74:101392, 2023.
- S. Farrar, M. Ryan, D. Ross, and A. Ludbrook. Using discrete choice modelling in priority setting: an application to clinical service developments. *Social science & medicine*, 50(1):63–75, 2000.
- V. Galassi and R. Madlener. The role of environmental concern and comfort expectations in energy retrofit decisions. *Ecological Economics*, 141:53–65, 2017.

- M. Gracia. [Les sociétés de tiers-financement en France : 5 enseignements à partager avec les guichets uniques en Europe](#). Technical report, Association SERAFIN, 2025.
- N. Hanley, D. MacMillan, R. E. Wright, C. Bullock, I. Simpson, D. Parsisson, and B. Crabtree. Contingent valuation versus choice experiments: estimating the benefits of environmentally sensitive areas in scotland. *Journal of agricultural economics*, 49(1):1–15, 1998.
- C. A. Holt and S. K. Laury. Risk aversion and incentive effects. *American Economic Review*, 92(5):1644–1655, December 2002.
- D. Kahneman and A. Tversky. Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2):263–291, 1979.
- I. Krinsky and A. L. Robb. On approximating the statistical properties of elasticities. *The Review of Economics and Statistics*, 68(4):715–719, 1986.
- D. McFadden. Conditional logit analysis of qualitative choice behavior. *Frontier in Econometrics*, 1972.
- National Audit Office (UK). [Green Deal and Energy Company Obligation](#), 2016.
- ONPE. [Prêt avance mutation \(PAM\) et Prêt Avance Mutation à taux zéro](#), 2024.
- C. Propper. Contingent valuation of time spent on nhs waiting lists. *The Economic Journal*, 100(400):193–199, 1990.
- M. Ryan and S. Wordsworth. Sensitivity of willingness to pay estimates to the level of attributes in discrete choice experiments. *Scottish Journal of Political Economy*, 47(5):504–524, 2000.
- Service des données et études statistiques (SDES). [Prix de l'électricité en France et dans l'Union européenne en 2024](#). Technical report, Ministères Aménagement du territoire Transition écologique, 2025a.
- Service des données et études statistiques (SDES). [Prix du gaz naturel en France et dans l'Union européenne en 2024](#). Technical report, Ministères Aménagement du territoire Transition écologique, 2025b.
- Service Public. [Non-interest bearing advance loan \(also known as Renovation advance loan - PAR +\)](#), 2025.
- K. E. Train. *Discrete Choice Methods with Simulation*. Cambridge University Press, 2009.
- J. A. van Oorschot, E. Hofman, and J. I. Halman. Upscaling large scale deep renovation in the dutch residential sector: A case study. *Energy Procedia*, 96:386–403, 2016.
- J. A. Vogel, P. Lundqvist, and J. Arias. Categorizing barriers to energy efficiency in buildings. *Energy Procedia*, 75:2839–2845, 2015.



## B. RISK AVERSION ASSESSMENT

Risk aversion assessment was performed inspired by a simple exercise derived from [Holt and Laury \(2002\)](#). Participants were presented with those choices after the DCE. In order to be concise and not lose attention, we restricted the experiment to four simple tradeoffs, that are displayed in Table 12. To relax participant's tension following the DCE, we chose to present simple lottery choices. When participants shifted from A to B define whether they are risk averse or risk-takers at different levels. Option A is the more valuable in the first two lines of the table, otherwise Option B is the most valuable. Because the range between the payoffs is greater in Option B, it seems riskier. In the last column of Table 12, we indicate what risk-aversion qualification we used for participants when they shifted from A to B at this point.

**Table 12: Risk aversion experiment and corresponding aversion labels**

Option A	Option B	Shift
Win €200 with 10% chance Win €160 with 90% chance	Win €385 with 10% chance Win €10 with 90% chance	Very risky
Win €200 with 40% chance Win €160 with 60% chance	Win €385 with 40% chance Win €10 with 60% chance	Risky
Win €200 with 70% chance Win €160 with 30% chance	Win €385 with 70% chance Win €10 with 30% chance	Moderate
Win €200 with 90% chance Win €160 with 10% chance	Win €385 with 90% chance Win €10 with 10% chance	Risk averse

**Note:** Participants that shifted at the last choice are Risk averse because they shifted "late" in the experiment, and could have had a higher average payoff "earlier" in the experiment

## C. REPRESENTATIVITY

**Table 13: Individuals characteristics**

	Frequency	Frequency in SRCV
<b>Sex</b>		
Woman	0.48	0.33
<b>Age</b>		
< 30	0.01	0.019
30 - 39	0.117	0.110
40 - 49	0.267	0.174
50 - 64	0.361	0.303
> 65	0.246	0.394
<b>Income</b>		
< 1,250€	0.019	0.06
1,251€ - 2,120€	0.094	0.183
2,121€ - 2,920€	0.205	0.169
2,921€ - 4,120€	0.296	0.249
4,121€ - 5,267€	0.205	0.144
> 5 267€	0.181	0.194
<b>Profession</b>		
Farmers and operators	0.01	0.03
Artisans, merchants, and business owners	0.045	0.097
Managers and senior intellectual professions	0.34	0.29
Intermediate profession	0.09	0.27
Employee	0.16	0.13
Worker	0.023	0.18
Others	0.05	0.002
Retired	0.29	(-)
<b>Education</b>		
Middle school of lower	0.06	0.06
High school diploma	0.16	0.33
Technical university degree	0.2	0.1
Bachelor's degree	0.25	0.28
Master's degree	0.27	0.14

**Note:** The second column indicates the proportion based on the characteristics (column 1) of our sample. The third column gives the proportions in the SRCV\_2023 database restricted to owner-occupiers of detached houses. us, Thus 1% of those participating in the experiment were under 30 years of age. In 2023, according to the SRCV survey, 1.9% of owner-occupiers lived in detached houses.

**Table 14: Housing characteristics**

	Frequency	Frequency in SRCV
<b>Running mortgage</b>		
No	0.487	
Yes	0.511	
Does not know	0.002	
<b>Urban area</b>		
2,000 - 100,000	0.352	0.378
> 100,000	0.249	0.218
Agglo Paris	0.109	0.070
Rural	0.291	0.334
<b>Region</b>		
North and East	0.198	0.215
West	0.280	0.249
Paris and surroundings	0.143	0.156
South-East	0.241	0.250
South-West	0.139	0.130
<b>Housing floor area</b>		
< 50 m <sup>2</sup>	0.002	0.014
51-70 m <sup>2</sup>	0.025	0.053
71-80 m <sup>2</sup>	0.035	0.084
81-90 m <sup>2</sup>	0.066	0.112
91-100 m <sup>2</sup>	0.121	0.188
101-115 m <sup>2</sup>	0.170	0.111
116-130 m <sup>2</sup>	0.187	0.186
> 130 m <sup>2</sup>	0.390	0.220
does not know	0.004	-
<b>Number of rooms</b>		
<3	0.031	0.12
4	0.066	0.31
5	0.125	0.31
6	0.214	0.16
> 6	0.56	0.1
does not know	0.002	(-)
<b>Building date</b>		
< 1950	0.263	
1951 - 1970	0.135	
1971 - 1990	0.220	
1991 - 2010	0.230	
2011 - 2020	0.107	
Does not know	0.012	
> 2020	0.033	

**Note:** As in the previous table, the second (and third) columns show the frequencies based on the characteristics (column 1) of our sample (taken from the SRCV database limited to owner-occupiers of detached houses).

#### D. RESPONDENTS AWARENESS

Table 15 provides information on respondents' knowledge of renovation subsidies.

**Table 15: Participants knowledge of common subsidies**

Subsidy	Freq. of aware respondents
Ma Prime Rénov'	0.78
Zero-Interest Loan	0.38
Discount on VAT (5%)	0.38
ANAH	0.32

**Note:** Among above policies, some are direct subsidies, as Ma Prime Rénov'. ANAH stands for "Agence National de l'Habitat" (*National Housing Agency*) and provides support to homeowners keen to retrofit.

## E. INTERACTIONS

### E.1 Interactions between attributes

**Table 16: Interactions with *Savings* and *Comfort***

	Third-Party (1)		Mortgage (2)	
ASC	0.332**	(0.129)	0.403***	(0.131)
Cost	-0.024***	(0.003)	-0.032***	(0.004)
Savings	0.016***	(0.002)	0.019***	(0.002)
Comfort	0.047***	(0.017)	0.061***	(0.017)
OSS	0.079	(0.058)	0.134**	(0.061)
Finance scheme	0.366**	(0.157)	0.318**	(0.161)
Finance scheme × Comfort	-0.060	(0.049)	-0.042	(0.051)
Finance scheme × Savings	-0.0003	(0.003)	-0.003	(0.003)
ASC × Risk aversion	1.543***	(0.253)	1.407***	(0.220)
Observations	3,084		3,072	
Log Likelihood	-3,066.405		-2,918.494	

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**E.2 Interactions with individual specific characteristics**

**Table 17: Interaction effects: Comfort × income**

	Third-Party (1)		Mortgage (2)	
ASC	-0.545	(0.476)	1.139*	(0.671)
Cost	-0.025***	(0.003)	-0.033***	(0.004)
Savings	0.016***	(0.002)	0.018***	(0.002)
Comfort	0.167	(0.120)	0.499***	(0.186)
Comfort × Income				
1,251–2,120	-0.057	(0.112)	-0.489***	(0.183)
2,121–2,920	-0.009	(0.108)	-0.481***	(0.177)
2,921–4,120	-0.057	(0.106)	-0.475***	(0.176)
4,121–5,267	-0.103	(0.108)	-0.493***	(0.177)
> 5,267	0.107	(0.108)	-0.402**	(0.178)
OSS	0.086	(0.058)	0.141**	(0.061)
Finance plan	0.221***	(0.055)	0.129**	(0.058)
<b>Interactions with ASC*</b>				
Risk aversion	1.134***	(0.269)	0.917***	(0.237)
Age	0.016***	(0.004)	0.018***	(0.004)
Woman	-0.258***	(0.081)	0.316***	(0.081)
Income class				
1,251–2,120	0.222	(0.303)	-1.554***	(0.564)
2,121–2,920	0.174	(0.293)	-1.682***	(0.552)
2,921–4,120	0.162	(0.288)	-1.892***	(0.551)
4,121–5,267	-0.018	(0.291)	-1.699***	(0.555)
> 5,267	0.018	(0.294)	-1.602***	(0.558)
Feels cold in the dwelling	0.728**	(0.289)	0.012	(0.290)
Holds a credit	-0.128	(0.099)	-0.232**	(0.094)
Is worried about future bills	-0.208**	(0.084)	0.160*	(0.082)
Previously retrofitted	-0.723***	(0.088)	-0.464***	(0.087)
Observations	3,084		3,072	
Log Likelihood	-2,973.948		-2,848.220	

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01