CLIMATE POLICY INITIATIVE

Drivers of Thermal Retrofit Decisions – A Survey of German Single- and Two-Family Houses

CPI Report

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Executive Summary

Background and purpose

The German government is committed to reducing the primary energy demand of buildings by 80% by 2050. This requires increasing the rate of thermal retrofits from the current 0.8% to 2.0% per year. To explore how new and existing policies and programs could deliver the increased retrofit rate, this paper examines the thermal efficiency retrofit decision-making process among owners of single- and two-family homes. It is based on a survey of 2,000 households that have been divided into three categories based on where they were in the retrofit decision process:

1. Households that have neither implemented nor are planning a retrofit;
2. Households that are planning a retrofit within the next two years; and
3. Households that have implemented a retrofit within the last five years.

Observations and insights

1. *Households' motivations for pursuing a thermal efficiency retrofit:* The drivers for building thermal retrofits change as owners progress along the decision-making process.

    - The decision to conduct a building retrofit is perceived as a complicated process, requiring time and effort to identify and evaluate options.
    - The importance attributed to thermal comfort and reduced energy bills increases as the decision-making process progresses. Creating awareness of these benefits at earlier stages in the process may increase the pick-up rate of thermal retrofits.
    - Building appearance is the main trigger for planning and starting building retrofits. This points to opportunities to link thermal improvements to building appearance and to market retrofits by appealing to this interest.

2. *Concerns about building retrofits:* Households are most concerned about financing and the quality of the retrofit.
    - The retrofit process is often held up by high up-front costs and the reluctance of building owners to take on loans. Providing financial support may address these issues.
    - Households are concerned about the quality of the retrofit measures and services, pointing to the importance of instruments that guarantee quality, such as standards and labeling for material and equipment and the certification of installers.
    - For households at all stages, the building retrofit process is perceived as a complicated one that takes too much time and effort to research and for which finding the right options is too difficult.

3. *Modifications of the initial retrofitting plan during the decision-making process:* Households frequently adjust the thermal part of a retrofit during the decision process, usually by dropping components.

    - About 75-90% of households that change their plans (either drop or add components), do so because of high or attractive costs for certain measures. Financial support may be important in order to encourage households to follow through with their plans.

- Expert advice is as important as costs in influencing the decision to add, drop, or modify options.

4. *Information channels used during the decision-making process:* The key sources of information are the Internet, professionals, and personal communications.

   - The importance of the Internet throughout the retrofit process points to the value of ensuring the availability of effective information portals.
   - The reliance of households on information from construction industry professionals reflects their important role in providing deep expertise about the market.
   - The press can help to raise initial awareness about retrofit opportunities but is less frequently quoted by households who have already conducted retrofits. These households tend to rely more on professional advice.
   - Tools that rely on personal communications, such as forums, local programmes, neighborhood associations, and others, are also important sources of information.

5. *Financial motivators:* Consideration of a house as an investment that pays back is a key trigger for thermal retrofits

   - Investment payback was the most significant financial motivator for thermal retrofits and was increasingly important as the household proceeded through the decision process.
   - Households receiving KfW support are more likely to implement comprehensive thermal retrofits and to follow through with the scope of thermal retrofit throughout the process.

This study explores key motivators of thermal retrofit for homeowners at various stages of the decision-making process; additional analysis is required to understand this process more fully and to determine the effectiveness of existing policies in driving households towards implementation. To date, CPI has conducted analysis on financial incentives and information tools that support different stages of the process.

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1 Introduction

The German government is committed to reducing the primary energy requirement of buildings by 80% by 2050 (BMWi and BMU 2010). This requires increasing the rate of thermal efficiency retrofits[1] from 0.8% to 2.0% per year.[2] To explore how public policies and programs could more effectively increase the thermal retrofit rate, this paper examines the retrofit decision-making process of single- and two-family households.

This study surveyed consumers about their decision-making process regarding thermal efficiency retrofitting. Close to 6,000 German owners of single- and two-family houses were contacted, and 2,000 of them were ultimately surveyed via the Internet. The survey divided respondents into three categories of retrofitters:

- *"Non-planning Households"*: Households that have not pursued any thermal efficiency improvement measures in the past five years and that are not planning any in the next two years;

[1] By "thermal (efficiency) retrofit" this paper means a set of measures aimed at changing the main technical characteristics of a building and its systems in order to reduce energy consumption for space heating purposes.
[2] The yearly retrofit rate of outer walls with insulation is 0.83% (IWU/BEU 2010).

- *"Planning Households"*: Households that have not pursued any thermal efficiency improvement measures in the last five years but that are planning to do so within the next two years; and
- *"Action Households"*: Households that have pursued some thermal efficiency improvement measures in the past five years and that may or may not have plans for further retrofits in the future.

Respondents were considered to have pursued or planned retrofits if they had completed or planned any of the following thirteen measures, ranging from major building envelope insulation projects to paint jobs (Table 1). Respondents were considered to have pursued or planned thermal efficiency retrofits if they had completed or planned any of the three thermal measures listed in the 2nd column of the Table.

Table 1. Review of retrofit measures

Household retrofit measures	Thermal measures	Other measures
Refitting kitchen and/or bathroom		X
Rewiring		X
Repainting of walls		X
Insulation of the building envelope	X	
Replacing wall lathing, replastering, repairing cladding		X
Sealing air gaps in wall joints		X
Window and door replacement	X	
Significant repair or exchange of roofing and flooring		X
Installation or replacement of the space heating system	X	
Installation of photovoltaic panels, solar thermal systems for space & water heating or only water heating		X
House extensions		X
Space remodelling (installing a kitchen, changing the number of rooms in the house, or other space remodelling)		X
Insulation of water pipes, hot water cylinders, installing or changing heating controls (thermostatic radiator valves, thermostats, timers, boiler interlocks, and others)		X

Households' categorization as Non-planning, Planning, or Action was used as the main dependent variable in the analysis below. The statistical analysis aimed to elucidate the factors that motivate households to move from having no plans for thermal efficiency retrofits, to developing a plan, and, finally, to taking action. The differences in factors were systematically examined with the ultimate goal of providing recommendations for the formulation of policies to promote thermal efficiency in buildings. The results were controlled for building age, geographical distribution, homeowner age, and homeowner education level.

2 Observations and insights

About 6,000 German homeowners were contacted and 2,000 of them were surveyed, with a similar sample size from each German state. While the regional distribution was representative, the survey sample was biased toward younger respondents (mean=43 years). This may be because the questionnaire was administered through the Internet, which has a younger audience. In general, owners of older buildings were more likely to plan a retrofit or to have taken action, though the effect of building age was small. More educated respondents were more likely to have planned or implemented retrofits; respondents from East Germany were slightly less likely to have done so. The latter two variables correlated strongly with income (though income information was only available for a subset of

respondents). Below, we detail observations and insights about the drivers of thermal retrofits for residential buildings.

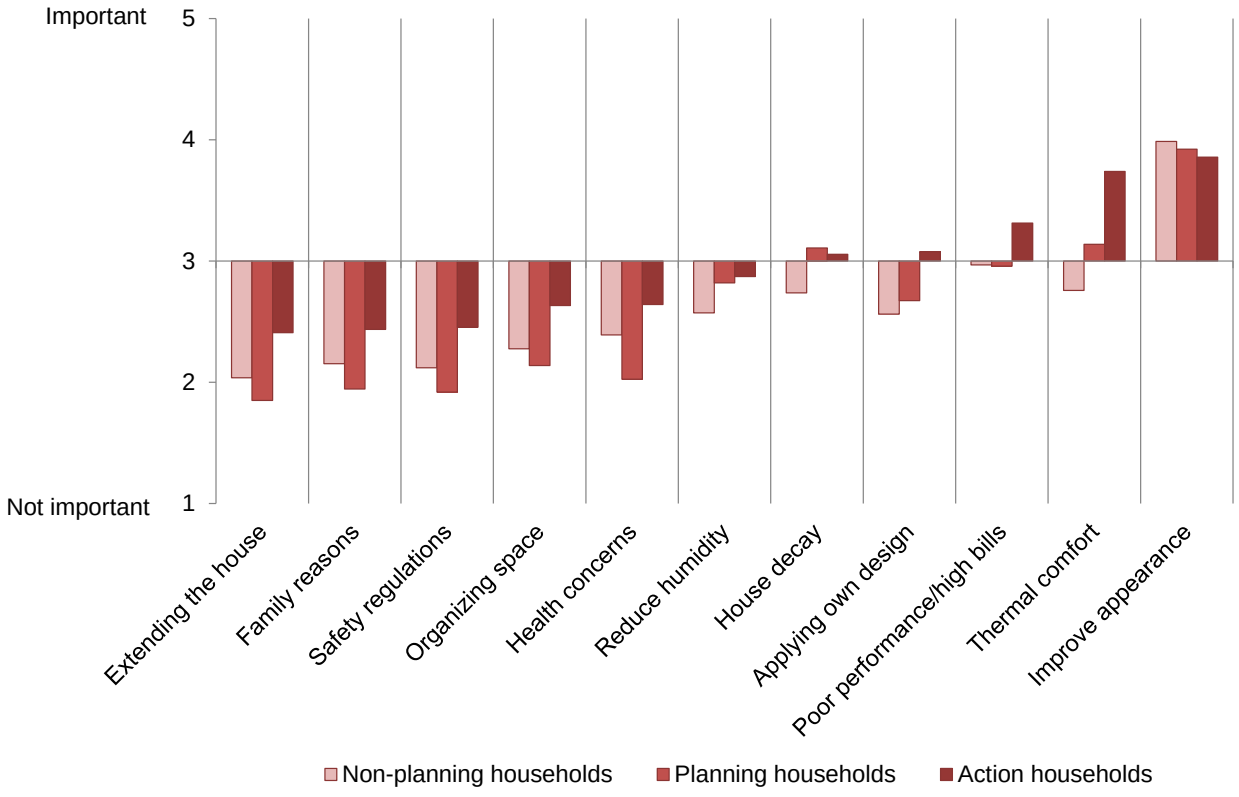
2.1 Initial motivation for planning and conducting thermal retrofits

In order to examine homeowners' motivations for conducting thermal retrofits of buildings, survey participants were asked about their reasons for planning or conducting retrofits in general. Figure 1 presents the results of the survey by household category. The Figure illustrates that the importance of some motivators remained the same for all decision stages, while other motivators were more important at some stages than at others.

The analysis shows that for households that are not planning thermal retrofits, building appearance may be an important motivation for doing so. For households that are already planning thermal retrofits, building appearance is still the key motivation but is less important than for non-planning households. Among planning households, thermal comfort and building decay are additional motivations. For those households that have already implemented a thermal retrofit, building appearance and decay are less important motivators, while thermal comfort, poor building performance/high energy bills, and structural redesign become much more important.

In summary, building appearance plays a key motivating role at all stages of the decision-making process. This observation suggests the potential effectiveness of policy tools that link thermal retrofits to general aesthetic considerations. Also, it may be helpful during the Non-planning and Planning stages to raise awareness about the thermal comfort and lower energy bills that result from a thermal retrofit, since these are the benefits most cited by households that have already conducted retrofits.

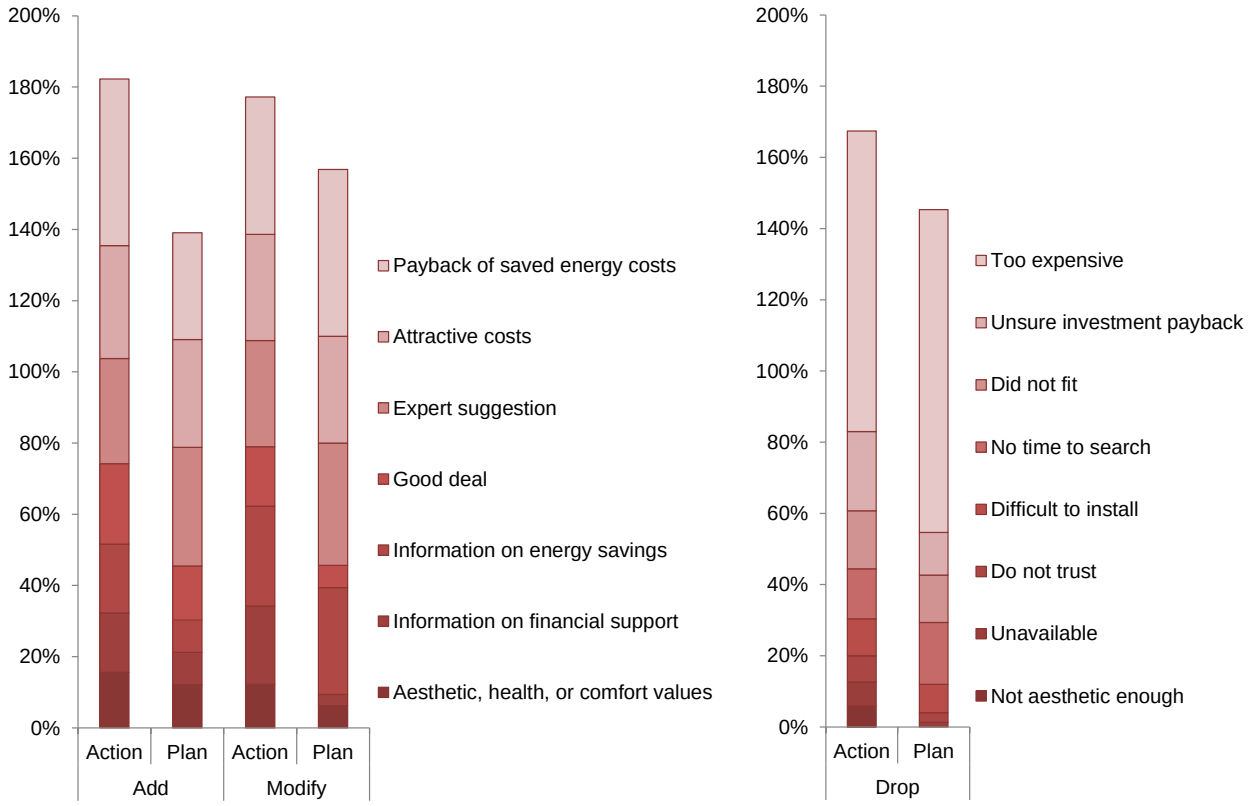
Figure 1: Initial motivation to start planning, to plan and to conduct thermal retrofits (ranked from "not important" to "important" for Action Households)



2.2. Revising the original building retrofit plan

Next, households at the Planning and Action stages were asked whether they had altered their initial building retrofit plan and, if so, what their reasons were for doing so. Figure 2 summarizes the reasons for dropping, adding, or substituting originally planned options. The Figure attests to the finding that financial motivations were the key factors for changing plans. More specifically, 75-90% of those who dropped options did so due to the high costs of these options, whereas a common reason for adding and/or modifying options was the attractive cost of these options. The next most important factor for modifying options was uncertainty about the payback period of saved energy costs resulting from the retrofit investments. These conclusions point to the importance of providing financial support for building thermal retrofits. The third most important reason for the modification of retrofit plans was experts' suggestions, signaling the importance of information availability and technological expertise in influencing decisions during the retrofit process.

Figure 2. Reasons for adding, modifying (left,) and dropping (right) options during the planning and implementing stages



Note: The shares of the sample affected are not additive because multiple answers were available.

2.3. Household experience with and concerns about building retrofits

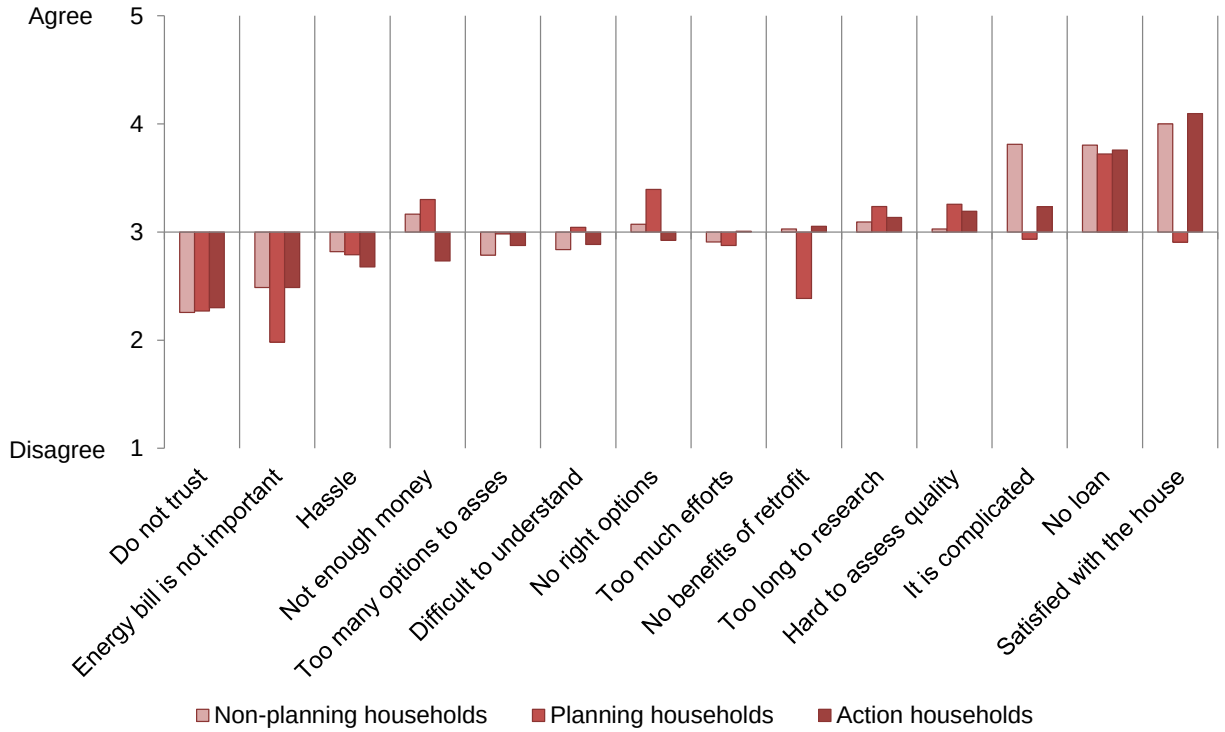
Households were then asked about their experience with and concerns about building retrofits; the results of this question are summarized in Figure 3. The key reason that non-planning households did not plan

building retrofits was that they were satisfied with their homes in their current states. Other concerns among non-planning households were that the retrofit process was too complicated, a lack of funds and reluctance to take on a loan, that too much time was required to research options, and a lack of the right options.

Comparing home satisfaction as displayed in Figure 3, it is clear that households that are dissatisfied with their homes are the ones that are more likely to implement plans; thus, the planning stage is a critical target for policies. The key concerns of households in the planning stage were the lack of funds, reluctance to take on a loan, lack of the right options, the time required to research them, and concern about the quality of options.

Households at the post-retrofit stage reported similar concerns – that the retrofit was a complicated process, they did not want to take on a loan, it required too much time to research, and it was difficult to assess the quality of options. Thus, the concerns about building efficiency retrofit among households prior to the planning stage coincide with those of households that have completed retrofit.

Figure 3. Household experience with and concerns about building retrofit (ranked from "Disagree" to "Agree" for Action Households)

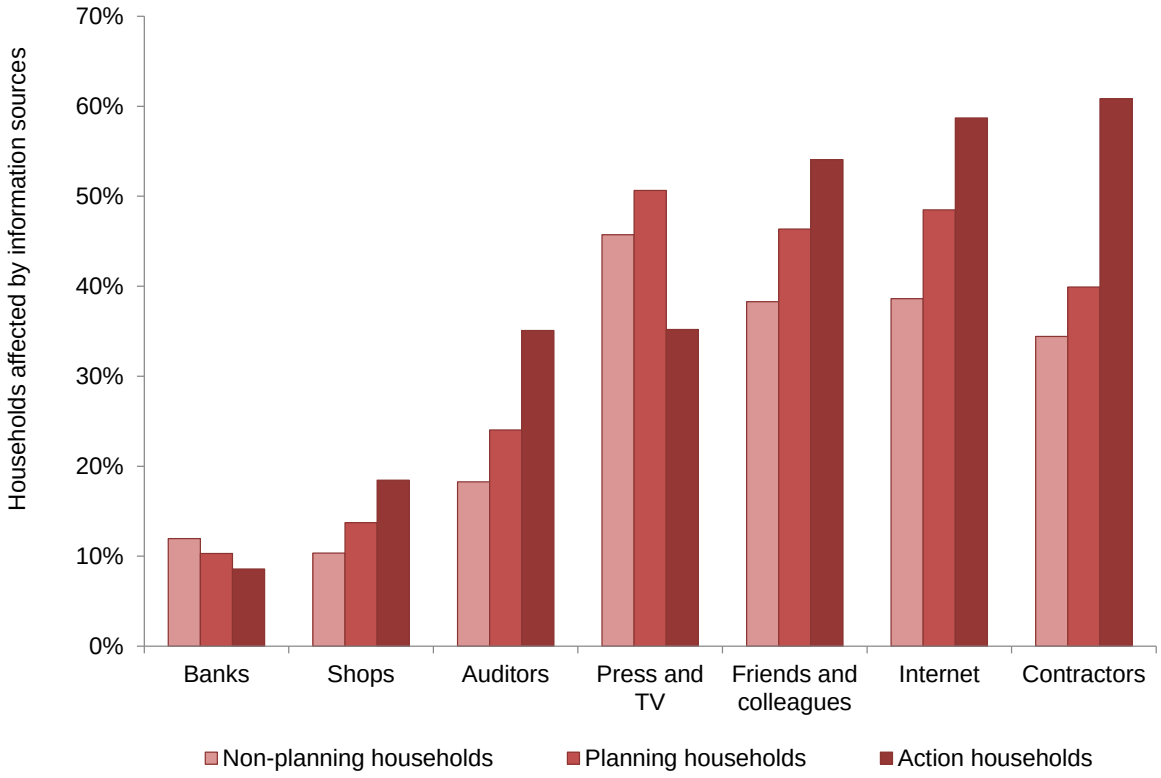


2.4. Sources of information about building retrofits

This section discusses the main sources of information used by households at different stages of the decision-making process. Figure 4 reveals that the key information sources during all stages are the Internet and construction industry experts. Both sources were identified as particularly valuable at the Planning and Active stages when technological options are selected and evaluated. Mass media, e.g. television advertisements and the press, were identified by Non-planning and Planning households as important instruments for raising general awareness about the benefits of thermal retrofits. However, these sources are not comprehensive and targeted enough to provide advice at the Action stage. Thus,

respondents who had already completed their retrofits were much less likely to identify the television or the press as a source of information and were more likely to have received information from energy auditors or builders. Interestingly, friends and colleagues had a high impact; this impact increased throughout the process and cumulatively was close to the impact of construction industry experts. This points to the usefulness of supporting policy tools that are based on personal communication, such as networking, forums, local programmes, neighborhood associations, and others (see local leadership programmes in Novikova and others 2011).

Figure 4. Percentage of households influenced by different sources of information about thermal retrofit

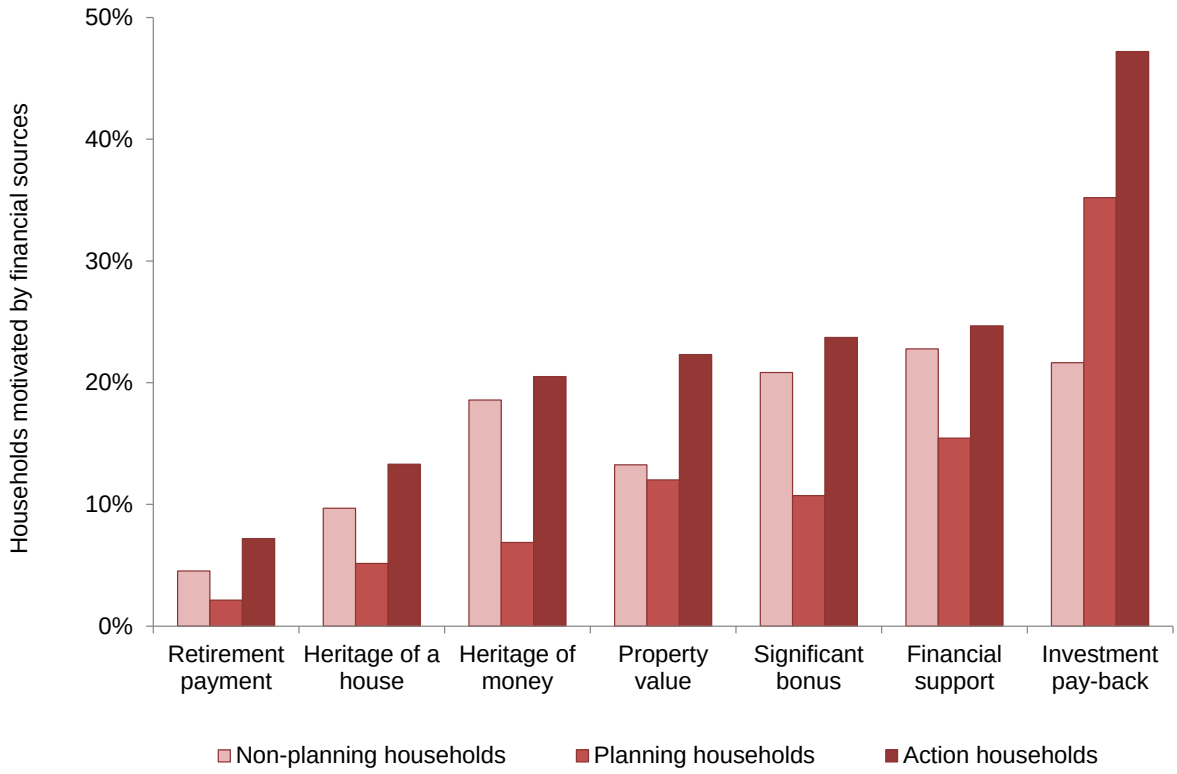


Note: In Germany, instead of contractors, the term “Handwerker”, which means “craftsmen”, is used.

2.5. Financial motivators and sources for building retrofit

A subsequent question investigated whether any financial motivators had driven or would drive people to retrofit their houses; Figure 5 presents the results of this question. The Figure illustrates that the consideration of a retrofit as an investment that would pay back was the most significant financial motivator for households. This motivator became more important to households as they moved from no plan, to planning, to implementation. Windfall resources such as bonuses, inheritance, retirement payment, and other unexpected financial support were also significant financial factors for the pursuit of retrofits. Few people planned a retrofit in expectation of such financial sources, however, as they are usually difficult to predict. This could explain the lower significance of this factor for those in the planning stage and the higher significance for those who had completed a retrofit.

Figure 5. Percentage of households considering various financial factors as motivators for building thermal retrofits



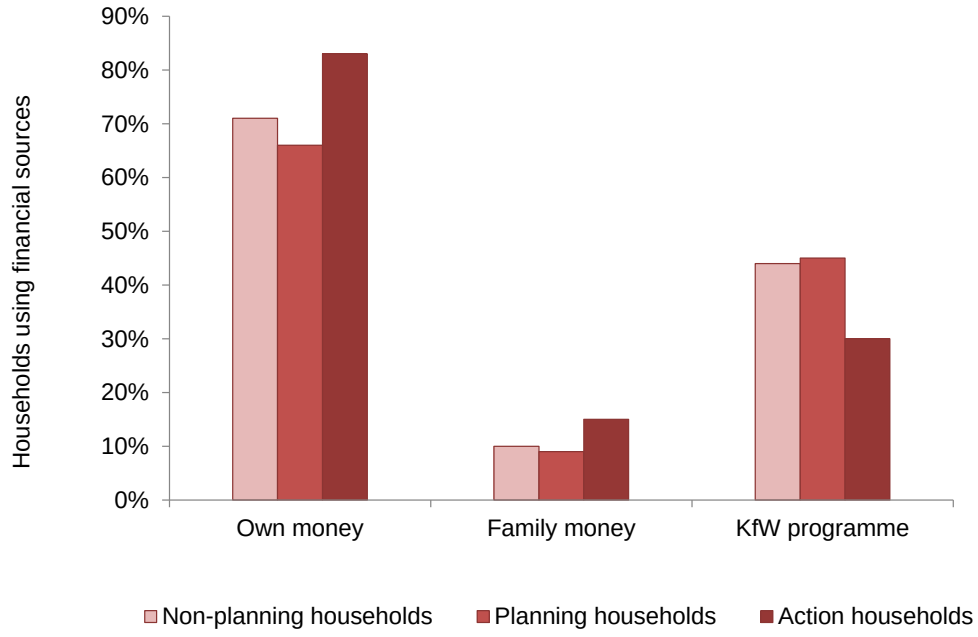
The next question asked about the type of finance that households envisaged using or had used. Figure 6 shows that respondents who have taken action are significantly more likely than respondents who are just planning a retrofit to declare their own money or family money as the financial resource for the retrofit. We also observe that action households used KfW programmes[3] ca. 15% less than planning households expected to use them. There are three possible explanations for this less than expected use:

- This share of respondents originally planned to use KfW finance but did not manage to get it;
- Planning households (who were more interested in the KfW programmes) planned to spend more on retrofits than action respondents who used their own funds. This could imply that the more comprehensive , more expensive, plans may be more difficult to realize than incremental investments and that households tend to drop components of their plan as they move through the process; and
- Action households had more access to their own funds than households in the planning stage.

The analysis also revealed that once KfW support was obtained, respondents were much less likely to drop energy efficiency options than when they got their money from other sources.

[3] The KfW programmes provide financial support for efficiency and renewable retrofit for several sectors of the German economy.

Figure 6. Percentage of households using various financial sources



3 Comparison of results with other studies

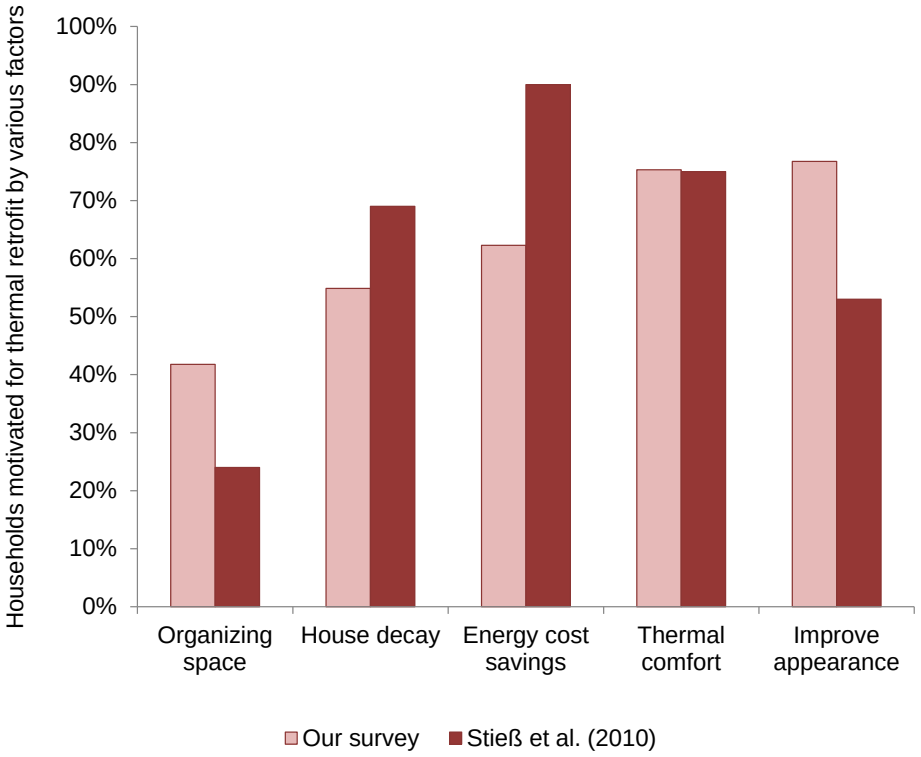
Two studies, by Technomar (2005) and Stieß et al. (2010), also examined German households' motivations for pursuing thermal retrofits. We describe the samples used by these studies in order to determine their comparability with the current survey and then compare selected research results.

Stieß et al. (2010) used a sample of ca. 1,000 owners of single- and two- family homes that had conducted major building renovations of thermal envelopes and heating systems (valued higher than EUR 4000) between 2005-2008. The sample was split between owners who conducted standard measures (e.g. standard heating system, painting of walls) and owners who conducted energy-related retrofits (e.g. pellet heating system, insulation of walls). A comparison of Stieß et al. (2010) and this survey was conducted only for those households that had recently made an energy retrofit and were therefore in an "active" stage according to our methodology.

The study by Technomar (2005) researched information instruments and barriers to the thermal retrofit of existing buildings through a survey of 400 owners of single- and two- family houses that had either conducted or planned modernisation measures (roof, heating systems, walls, windows). The sample was not split between general retrofits and thermal-related retrofits. Therefore, a comparison of results between Technomar (2005) and the present survey was made with caution.

Figure 7 compares the motivating factors for pursuing thermal retrofits that were listed by households in our survey and in Stieß et al. (2010). A comparison with the results of the Technomar study (2005) was not made, because the Technomar study does not distinguish energy efficiency retrofit from general retrofit. Both our survey and Stieß et al.'s (2010) conclude that saving energy costs and house decay rank among the most important factors for the retrofit. The importance of thermal comfort was ranked significantly higher as a motivator for retrofits by Stieß et al. (2010), whereas our survey ranked building appearance higher.

Figure 7. Comparison of motives for thermal retrofit among studies



The information sources used by active households were compared across all three studies. All studies agreed on the key role played by contractors in the decision-making process. Information received from personal communications, e.g. friends and colleagues, was also identified in both studies as significant. Survey results differed, however, with regard to the importance of the Internet. Stieß et al. (2010) found that the Internet was used by only 50% of respondents and was thus less important than personal communications and contractors, while we found that the Internet was almost as important as contractors and more important than personal communications. Technomar (2005) estimates that the Internet was used among only ca. 5% of households. The high figures in our survey for the Internet as an information source could be because our survey was Internet-based, whereas the very low figures reported by Technomar (2005) may be due to the fact that it was conducted before online building analysis tools and online guides were widely available in Germany.

Using different indicators, all three studies agreed that up-front costs are a key barrier to the pursuit of building retrofit. Technomar (2005) reported that lack of financing was the main barrier while Stieß et al. (2010) and this study found that reluctance to take on a loan was the key factor.

4 Conclusion

This paper aimed to identify and quantitatively assess drivers for implementing thermal efficiency retrofits. Behavioral and economic reasons were studied along different stages of the decision-making process.

We conclude that motivations and financial reasons for engaging in thermal efficiency retrofits change as households go through the thermal retrofit process. This paper also reveals that the usefulness of particular information sources changes over time. The implication is that policy tools should be tailored to specific barriers and opportunities associated with different stages of the decision-making process.

The conclusions of this paper are generally in line with those of other recent studies on the topic. However, more research is needed to more fully explore the thermal efficiency decision-making process. In light of the paper's findings, an assessment of policies from the point of view of their ability to move households from one stage to the next and address challenges associated with each stage will be useful.

5 References

BMWi, BMU. 2010. Energy Concept for an Environmentally Sound, Reliable, and Affordable Energy Supply. Berlin: BMWi.

IWU/BEI. 2010. Datenbasis Gebäudebestand. Datenerhebung zur energetischen Qualität und zu den Modernisierungstrends im deutschen Wohngebäudebestand. Darmstadt.

Novikova A, Amecke H, Neuhoff K, Stelmakh K, Kiss B, Rohde C, Dunkelberg E, Weiss J, Matscoss K, Darby S. 2011. Information tools for energy demand reduction in the existing residential buildings. Climate Policy Initiative.

Stieß I, van der Land V, Birzle-Harder B, Deffner J. 2010. Handlungsmotive, -hemmnisse und. Zielgruppen für eine energetische Gebäudesanierung. Frankfurt am Main.

Technomar Gmbh. 2005. Abbau von Hemmnissen bei der energetischen Sanierung des Gebäudebestandes. Munchen.