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From collective to individual decision-making: barriers and opportunities to improve the success rate of the energy retrofits in the Dutch owner-occupied sector

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Abstract. The building sector can contribute considerably to reducing global greenhouse gas (GHG) emissions. In the Netherlands, the GHG emissions must be mitigated by 95% by 2050 relative to the 1990 baseline. Various factors, such as low renovation rates cause uncertainties in reaching these targets. The current study aims for investigating the barriers and opportunities regarding the energy efficiency renovations (EER) and programs offered by the cities in the Netherlands. Homeowners encounter individually and collectively different forms of barriers during their journeys of EERs. By collective decision-making, we mean when an individual homeowner cannot make the final decision on EER by themselves. Homeowners may have to decide together with other homeowners or even tenants in case of living in a multi-family dwelling. The local authorities sometimes offer the energy efficiency programs at neighbourhood levels and the agreement of most households is essential for the continuation of the energy efficiency programs. The literature review, semi-structured interviews and focus groups are conducted with experts from the largest cities in the Netherlands. The focus groups and interviews are used to examine the barriers and opportunities especially at neighbourhood and street levels. Our main initial findings include the barriers of (a) Individual homeowners: difficulties in making them interested to conduct EER, lack of knowledge for the starting point of renovation, additional barriers of following many steps in conducting EERs for the old dwellings; (b) Homeowner associations: difficulties in reaching agreement by 70% of homeowners, time-consuming process for agreement, and not well-organised meetings by all the homeowners' associations; (c) Neighbourhood level: cultural diversities, difficulties in finding solutions for different groups of people, etc.

Keywords. Energy efficiency renovation, Individual homeowners, Homeowner association, Decision-making, Behavioural factors, Transaction cost barriers, Neighbourhood approach.
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1. Introduction

The building sector accounts for 25% of global greenhouse gas (GHG) emissions. The United Nations has announced a global action to reduce GHG emissions. In the Paris climate agreement, 200 countries agreed to limit global warming to no more than 2°C above pre-industrial levels. The Netherlands has set a target to stop using natural gas for heating and cooking by 2050. Most homes in the Netherlands are owner-occupied. The proportion of newly built homes is also low. Considering these two factors, renovating owner-occupied homes can contribute significantly to achieving the energy efficiency targets in this country.

The Netherlands, following the European Commission's policy, focuses on neighbourhood or district approaches. Recently, local authorities promoted energy retrofits through various support. They provide financial support, communicate with homeowners about collective solutions such as district heating, and offer cost-efficient and sustainable renovations for specific buildings and households. In implementing these approaches, municipalities also face many challenges. The local authority provides the whole package of technical and financial support. However, some homeowner associations did not participate in the programs. As a result, other factors may hinder the adoption of the energy efficiency technologies offered by the communities. The local authorities need to figure out how to change household behaviour by identifying the key motivations and barriers to sustainable

renovations.

The behavioural factors and the transaction cost barriers significantly influence the homeowners' decisions to conduct energy retrofits based on the literature review [1]–[6]. Behavioural factors contain contextual (e.g., building characteristics), motivational (e.g., comfort improvement), and personal (e.g., awareness of energy use) factors [1], [2]. Transaction cost means any hidden costs incurred by a transaction with an external source, such as finding a reliable contractor [7]–[9]. However, few studies have examined the impact of behavioural factors and transaction cost barriers on the individual homeowner's decision to make energy retrofits. The number of studies on these influencing factors for condominium associations is even more restricted. This study aims to fill the gap in the literature by examining behavioural factors and transaction cost barriers for individual homeowners, homeowner associations.

This study aims to answer the research question: how can the success rate of the current practices on energy efficiency renovations be improved in the owner-occupied sector? We investigate the current energy efficiency programmes focusing on the owner-occupied housing sector at different levels: individual homeowners, condominium associations in the three largest cities in the Netherlands, i.e., Amsterdam, Rotterdam, and The Hague. We conduct a literature review, semi-structured interviews, and focus groups to investigate the research problem of this study. First, we examine the initial barriers through semi-structured interviews with the experts of three municipalities on energy efficiency programs. Then, we collect a group perspective through focus group sessions on the initial hindrances and drivers of homeowners' energy retrofits. The purpose of focus group meetings is to evaluate the best practices in the largest cities in the Netherlands.

2. Review of earlier studies on the barriers and opportunities towards energy retrofit

2.1 Individual homeowners' decision-making process

The homeowners experience different stages in their journeys of energy retrofits. Homeowners need to fulfil the pre-conditions to start the customer journey, such as perceived needs and social norms by homeowners [10]. In addition, these people have specific thoughts, experiences, and social networks before and during their journeys that considerably determine their decisions. The energy retrofit journey consists of different stages/moments: (1) the homeowner becomes aware of energy retrofit; (2) the homeowner becomes acquainted with the potential options for their dwellings, delay, or resistance against the energy retrofit options. (3) the homeowner may choose to continue for the renovation; (4) the energy retrofit/s may be implemented if the homeowner decides to continue the process; (5) after implementing the energy retrofits, the homeowner experiences the benefits/disadvantages of new technologies. This homeowner may also share the experiences with other neighbours/social networks [1], [8], [11]. The behaviour influencing factors and transaction cost barriers determine the renovation decision. The behavioural factors influence the behaviour before the decision stages, and the transaction cost barriers influence after the decision stages.

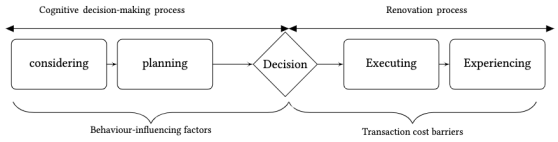

Fig. 1 – Stages of a renovation process of an individual homeowner using the literature review.

(1) Awareness of energy retrofits. Becoming aware of energy retrofits depends on the homeowners' cognitive capability. The behavioural factors of household characteristics, attitudes, and beliefs towards energy retrofit determine the homeowner awareness. Also, the complexity of processing information hinders homeowner awareness. The building is also an important factor since the renovation needs to be implemented based on the dwellings' characteristics. Becoming fully aware of energy retrofits is not easy. Homeowners encounter many barriers even at the first stage. The homeowners may have difficulties processing the information provided by external parties when the information is not clear, concise, and convincing [8], [12]. For instance, many homeowners are not interested to read the letters provided by public authorities. These letters are usually too long and not appealing to people. Homeowners may be uncertain if they live in the current dwellings for the future. This type of uncertainty may hold back the homeowners' willingness to invest in energy retrofits [13].

(2) Positive/negative attitudes towards energy retrofits. After becoming aware of the importance of energy retrofits, homeowners make a positive/negative attitude towards the energy retrofits. This stage is also part of the decision-making process. Therefore, cognitive awareness and biases are the main determinants of this stage. In addition, homeowners' experiences and social networks have critical roles in making positive/negative attitudes towards energy retrofits. The perceived attributes of energy retrofits, such as cost-saving, are one of the main determinants of positive/negative attitudes to retrofits.

    Homeowners may perceive the hassle, mess, and nuisance during the execution phase. They may also experience technical restrictions in the dwellings and low energy prices [2], [8], [13]. These are examples of transaction cost barriers that originated from external sources.

(3) Finalising decision to stop/continue the energy retrofits. Homeowners need to find specific information on the appropriate types of energy retrofits and reliable contractors to install the energy retrofits. Therefore, homeowners must interact with external parties to find reliable information and contractor. These external parties are, for instance, contractors, energy experts, energy efficiency technologies suppliers, banking

systems for financial sources, and homeowner associations. Homeowners may also need to interact with their neighbours if an agreement with neighbours is essential. From this stage onward, the transaction cost barriers significantly influence the final decision and implementation of energy retrofits.

Homeowners may have difficulties in finding reliable information and contractor. They may spend much time finding all the essential sources of a reliable expert or subsidies for the renovation. The planning time may also slow down the process. Uncertainties of the benefits, negative experiences, and complexity of regulations by public authorities are other sources of transaction cost barriers for homeowners [9], [14]-[16].

(4) Implementation of the energy retrofits (implementation phase). At this stage, homeowners live in a dwelling where a contractor executes the energy retrofits [3], [11]. Many factors can facilitate this process for homeowners, such as experiences and skills of previous renovations, confidence while implementing, and particularly supports from family, friends, and acquaintance [2], [17]. Homeowners need to find the energy retrofit activities in which they should supervise. They also must examine how much hassle and mess the renovation may bring. Furthermore, complexity in doing renovation and lack of trust between the contractor and homeowners may delay/stop the implementation of the energy retrofits [15], [16], [18].

(5) Experience of the energy retrofits. homeowners evaluate the effect of the installation of energy retrofit and form a positive/negative attitude toward it. Homeowners may disseminate their experiences through their social network since other homeowners, who have not completed the entire customer journey, can learn from these experiences. Homeowners may also think about the next steps of renovations, for instance, whether homeowners need to conduct other renovations for the better performance of the current energy retrofits [3], [11], [13].

2.2 Homeowners association decision-making process

Promoting energy retrofits is challenging for condominium associations. Previous research has identified six steps when condominium associations perform sustainable renovations. Condominium associations begin the renovation process for different reasons, including a long-term building maintenance plan, a proposal from a member of the condominium association, or a sustainable renovation grant programme offered by a government agency. The second step is for the homeowner's association members to evaluate the possible sustainable renovation options. The third step is to consider various options and decide. The fourth step is for the condominium associations to collect votes for the feasibility study of the different renovation measures. A feasibility study is essential in this step as it significantly influences member decisions. If homeowners vote for a renovation, the responsible members solicit bids and prepare a business case. The condominium association votes for the second time if the board finds the business case profitable. After this step, the condominium association implement the energy retrofit if most members approve the plan.

The main influencing factors are like individual decision-making processes, such as the availability of financial sources for implementing retrofit. The financial support can be provided by the financial savings of the condominium associations or condominium association members or by the financial support of the public sector. Condominium associations may also be motivated by the payback period or expected cost savings of energy conservation measures. The presence of a professional party providing technical assistance at various stages can speed up the decision-making processes of condominium associations. On the other hand, the absence of trusted professional support or contractor is a transaction cost barrier that hinders the decision-making process of the condominium association. In addition, group dynamics influence the decision-making processes of condominium associations. For example, conflicts of interest among condominium association members prolong the renovation process. Communicating the benefits of an appropriate energy conservation measure among residents can stimulate the energy retrofit and facilitate agreements among members. The knowledge and characteristics of the members also determine the decision to make sustainable renovations. In some apartments, both tenants and owners live in the same buildings. In this case, the decision-making process for sustainable renovations becomes even more complicated as it requires the agreement of both parties [19-22].

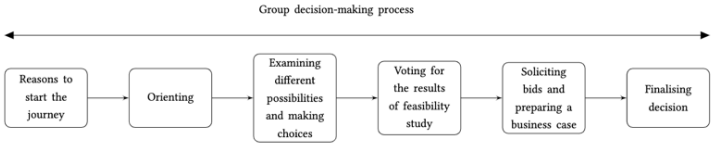

Fig. 2– Stages of group decision-making process of homeowner condominium using the literature review.

3. Research methods

The semi-structured interviews and focus group sessions are conducted to collect the data.

3.1 The Semi structured interviews

We collected information about the barriers and opportunities of energy retrofits in the owner-occupied housing sector. We asked similar questions in all interviews and defined new questions based on the previous interviews. The duration was approximately 1-1.30 hours. 12 semi-structured interviews were conducted.

The interviews contain general information about the interviewees, aims and the target groups of the initiatives at the municipalities and barriers of energy

retrofits. The interviewees are the experts who are active in the energy transition programme in the Netherlands.

3.2 Focus group sessions

The focus group sessions aimed to investigate the obstacles and opportunities for individual and collective actions towards energy retrofits from group perspectives. We investigated the decision-making process, the barriers, the right message, the right messengers promoting sustainability. We examined these factors for the individual homeowners, homeowner associations and social housing corporations. Two focus group sessions (8 and 6 experts, respectively) are conducted to collect the data on the barriers and motivations to energy retrofits.

4. Results

The main identified barriers for individual homeowners and homeowner associations are as follow:

4.1 Individual homeowners' barriers to energy retrofits

Lack of technical knowledge on the appropriate types of energy retrofits during the planning phase. During the first focus group meeting, an expert explained that it is always a big challenge for homeowners to figure out the most appropriate type of energy retrofit for their home. The energy advisor of the municipality provides technical information on the possible energy retrofit measures for the buildings. The final decision on the most appropriate energy retrofit requires more specific technical advice for the dwellings providing information on the feasibility of the energy retrofit and the phases that the homeowners need to follow.

Lack of technical knowledge during the implementation phase. In one programme, an expert only provides the necessary information about the types of energy-efficient measures. The target group for this program has a positive attitude towards energy-efficient retrofits. Two groups of households are identified. The homeowners who are well motivated. This group is proceeding with the implementation. The other group is also interested, but their main obstacle is the lack of knowledge on how and where to begin energy retrofit. This program does not yet consider the obstacles in the implementation phase.

Complexity and hassle factors during the implementation phase. The owners of old buildings specified the reason for not continuing with energy renovations. The main obstacle is the complexity and effort involved in the energy retrofitting of old buildings. Homeowners must follow many steps which were not provided within the programme offered by the local authority. Therefore, homeowners must apply to other programmes to receive technical, informational, and financial assistance.

Time and effort in finding reliable experts, reliable information, and financial sources. In the homeowner association grant programme, homeowners invest a long time to get an estimate from a contractor and financial assistance. The homeowners receive different financial advice. They ask about the reliability of the financial advisor. The municipality cannot provide information on the reliability of financial advisors. During the implementation phase, Homeowners also face the challenge of finding a reliable contractor. It is also a challenge for the municipality to help homeowners identify a reliable contractor. In some local authorities, an external party gives neutral advice on the reliability of professional contractors.

Lack of interest in reading the letters from public authorities. Residents are reluctant to respond to letters from the authorities. The reason could be that people receive so many letters to pay their bills that they are unwilling to respond to more letters. In another experiment, the energy expert spoke to people in a neighbourhood. In the end, people responded and acted on their conversation with the energy expert.

High costs for deep renovations and uncertainties about the benefits of energy refurbishments. According to the experts' observations, people prefer to start with small energy retrofits and avoid investing high capital costs in energy retrofits due to other necessary living expenses. In addition, the project manager of the condominium association grant programme explained that owners of multifamily buildings must pay various types of costs for their buildings, such as the elevator. Individual owners may not see the value in paying additional costs for energy retrofits with uncertain benefits. A project manager of incentive programmes for larger condominium associations emphasised that the cost of energy retrofits is the key factor in the final decision, regardless of the condominium owners' willingness and interest in energy retrofits. The energy retrofits must also provide short-term benefits. Otherwise, homeowners will not invest in something that does not pay for itself within five years, given other expenses and financial investments.

The complexity of the process of application for accessing financial resources by public authorities. Homeowners interested in energy retrofits regularly ask for assistance in applying for grants/loans, although there are numerous programmes and online platforms for grants, loans, and aid. As homeowners found out where they could access funding sources. They also wanted to know if those funding sources were still available long before they made their final decision. All kinds of uncertainties also hinder the process, such as the likelihood of getting the grants/loans/grants, the impact of changes in political parties on financial support for energy retrofits, and the right time to invest.

Homeowner uncertainties regarding the policies, such as removing the natural gas from the heating system. Homeowners must recognise the need and urgency for energy retrofits to act. Most people are reluctant to act until they are less uncertain, and those actions become the social norm. For example, homeowners need to know exactly how to remove natural gas from their heating systems. Currently, residents are very unsure about removing natural gas, so it is difficult to motivate them to begin the process. There could be an explanation for this, such as miscommunication by officials regarding energy retrofit programmes and public-private initiatives. For example, the city government promises to plan for the

elimination of natural gas in the heating system. However, the planning for individual districts is not entirely clear.

4.2 Homeowner associations' barriers to energy retrofits

Homeowners' associations also use voting to make the final decision. In the Netherlands, the positive vote of 70% of the individual homeowners is crucial for the renovation to proceed. The lack of approval can have several reasons, such as differences in groups of people (e.g. young vs. old generation, low vs. middle income), lack of financial savings, such as a low budget for energy renovations, or lack of knowledge of members of housing associations about the benefits of energy renovations.

Lack of financial savings by homeowners' associations. From the condominium association grant programme, it was found that owners are interested in renovating and maintaining the buildings. However, condominium associations usually have difficulty in having sufficient sources of funds for capital expenditures. In addition, community fund managers only provide the loans if the condominium associations can demonstrate that they can repay the total costs.

Conflicts of interest among homeowner associations' members. In smaller condominium associations, people are more likely to perceive their blocks of buildings as individual houses compared to larger condominium associations. For example, if a flat building consists of four houses, the units on the top and ground floors benefit more from the roof and floor insulation than the houses on the second and third floors. Therefore, these two units may not see the direct benefit of energy retrofits to the floor and roof insulation and resist the decision. To overcome this obstacle, the multi-annual maintenance plan can be used as the right time to combine with the energy retrofit. During this process, the benefits of energy savings can be highlighted to gain the approval of other homeowners who may not directly benefit from the energy retrofit.

In larger condominium associations, energy retrofits that benefit most homeowners from their installations, such as façade insulation, have a higher chance of acceptance by residents. The municipality of The Hague offers packages of energy retrofits for condominium associations where most residents can benefit from the energy retrofits. In the municipality's experience, condominium associations usually opt for the package with the highest financial benefits, i.e. with low investments and high energy savings. However, the benefits of the energy package may not be evenly distributed in the end.

Among residents of condominium associations, there are people who can finance energy retrofits more easily than others. As a result, it is much more difficult for these individuals to vote for expensive energy retrofits, such as solar panels. In addition, many condominium associations do not have access to government grants. Given the lack of savings and financial assistance, this is a barrier to members who cannot afford to spend the money on energy retrofits.

Complexities in making agreements among the members of housing associations and long delay in making the decision. This barrier is identified during the implementation of a project called 'sustainable broker' and 'homeowners associations funding program'. The first project provides the complete packages of financial and technical supports from the municipalities and only financial support by the second project. The project leaders explained that despite these full supports, homeowners' associations and social housing corporations did not succeed to get the majority of votes of all the tenants or homeowners in conducting renovations or energy retrofits. These neighbourhoods also contain a mix of social and homeowner dwellings in one building block which amplifies the complexities of making agreements of renovation from both associations.

Mismanagement by homeowners' associations, e.g., lack of organised meetings by homeowner associations. Collective action requires the agreement of all the participants. In the case of a programme, it is easier since the smaller homeowners' associations have been targeted. However, even for smaller ones, the homeowner associations act differently. For instance, some of them have an organised meeting which might not be the case. Therefore, uncertainties exist in achieving the targets of this project due to this reason.

4.3 Message effects

Homeowners may be at different phases of energy retrofits. Some of them are not even thinking about energy retrofits yet. Some are thinking about different types of energy retrofits, and others are already doing energy retrofits. They have different characteristics and needs for their houses. In the semi-structured interviews and the focus group session, the question was asked what messages the experts use to motivate households to carry out energy retrofits. The general answer to this question was that it depends on the context and the intermediary delivering these messages. For example, improving the quality of life is important for people who can repay the cost of energy retrofits. Similarly, the availability of financial support from national and local authorities may be more influential for people who cannot afford the cost. In addition, a combination of messages is used to motivate households to undertake energy efficiency retrofits. The main messages are described below:

Improving the quality of life. In almost all programmes, experts mentioned that using the word sustainability does not lead to the implementation of energy retrofits. Most people are motivated to renovate their homes if they feel it is necessary or perceives an improvement in their quality of life. For example, in a programme implemented by the municipality of Rotterdam, improving comfort by insulating the floor was the most attractive message for the residents of the North Region of Rotterdam, as people in this region struggle with cold floors.

Essential maintenance of the house. The necessary maintenance of the building was mentioned in all programmes as well as in the focus group meetings as the most important moment to motivate households to

participate in energy retrofits. For example, if the roof needs to be renewed, this maintenance can be combined with the insulation of the roof. The municipalities of Rotterdam and The Hague offer subsidies and financial options that oblige to use a part of the budget for energy renovation and the rest for maintenance of the building. This type of incentive seems to be very effective for the implementation of energy retrofits. This message applies to both individual homeowners and condominium associations.

In one of the regions in the southeast of Amsterdam, the households own very old buildings that need renovation. It would be impossible to ask people to bear the extra costs of energy renovations. However, if the expert can convince people that they will have a more comfortable home in the future, they may consider energy renovation.

Condominium associations: through the multi-year maintenance plans (MJOP). This message is only valid for condominium associations. Every homeowner association (VvE) is required by law to maintain a healthy reserve that can cover the costs of maintaining the property contained in the homeowners' association. The best way to ensure a realistic source of funds is to have a multi-year maintenance plan. The project manager of the condominium association grant program explains that this is the best time to motivate households to make energy improvements. In addition, condominium associations are most likely planning to fund the maintenance of the building and additional costs for energy retrofits need to be reconsidered. In this case, the financial support from the national and local governments can compensate for the budget deficit of the condominium associations.

Expected cost saving. If people have a clear idea of the expected cost savings from an energy retrofit, they will certainly consider it. For example, owners of buildings with the lowest energy labels, such as F and G, must pay hundreds of euros per month for energy costs. There were cases in the Southeast Amsterdam where the owners had to pay 4000 euros per year for energy costs. The Energy Ambassador explained to the building owners the benefits of energy renovation in terms of cost savings per year. In this way, the owner was convinced to carry out the energy refurbishments.

4.4 Messenger effects

The first moment of communication is critical to make homeowners interested and engaged in the energy retrofit programs. The local authorities realised that official communication through letters and municipalities ambassadors does not influence the households' energy retrofit decisions. Then, who should transfer the message to homeowners to motivate them in energy retrofits?

A trusted neighbour/person. It emerges from the focus group meetings that a building ambassador can also help to motivate people to make energy-efficient renovations. Government, local authority programme managers or housing associations are seen as third parties. Households may feel pressured by these bodies and resist the measures they propose to improve the sustainability of buildings. If a household is interested in energy retrofits, it would be much easier to motivate other households through this household than through external third parties. One expert said that if you have trust and some relationship with a person, you can convince them to do something. This can be a trusted neighbour or caretaker, and, in most cases, it is neither an expert nor someone from the municipality.

An expert hired by homeowners. If the homeowners are already positive about an energy retrofit and have gone through the consideration phase, an expert hired by the homeowners can effectively communicate the benefits and convince the homeowners to go through with the energy retrofit. For example, if someone wants to install a heat pump, the first action is to find a reliable expert who can provide them with information and services for installing the heat pump specifically for their building.

Energy ambassador. In the southeast of Amsterdam, it is more expensive to rent a house than to buy one with a mortgage from the banks. In this region, the lowest income households usually own a house. The owners of these houses perceive the condominium associations as their landlords. Any expenses that condominium associations demand is seen by them as additional costs. The homeowners may resist these costs, for example, to improve the energy efficiency of the buildings. Shared events and creating local networks, such as cooking together or playing sports, can be a safe environment to talk to homeowners about sustainability. The Energy Ambassador can combine these events into activities to put sustainability into practice. In this case, an event using visualisations or different languages of the region to communicate the benefits of a more comfortable home equipped with energy efficiency measures can also be helpful.

A front runner. In the focus group sessions, the experts mentioned that people may not even be thinking about energy retrofit. Moreover, most people wait for one person to implement the measure first, and if the results are satisfactory, they may follow that person. The environmentally conscious group of households could be an example of the front runners, as this group is actively looking for ways to live more sustainably. After this phase, if households decide to undertake energy retrofits, they may contact an expert they have hired themselves or who has been hired by the municipality to get information or other services, such as financial support, to continue the process. So it also depends on the stage of the energy retrofit. An expert hired by the homeowners can also effectively communicate the benefits and convince the homeowners to undertake the energy retrofit. In addition, experts hired by local governments often offer free services. So in this respect, homeowners can also benefit from these services.

5. Conclusions

The aim of this study was to examine current energy policy and public-private initiatives in the Netherlands. It investigated which messages and ambassadors are effective in promoting sustainability. In addition, the main identified barriers to energy retrofits were examined from the perspective of policymakers and practitioners. The data collection methods are semi-structured interviews and focus group meetings.

Promoting sustainable retrofits. The results of this study show that (a) the word sustainability does not persuade homeowners to make energy-efficient retrofits. The quality-of-life improvements expected cost savings, and integration of energy efficiency retrofits with basic home maintenance may convince individual homeowners to make the energy efficiency retrofits. (b) Municipal project managers have cited letters and surveys from government agencies as ineffective means of promoting energy retrofits. (c) Trustworthiness and familiarity of the energy ambassador with households are the most important attributes to increase the effectiveness of energy programmes or household adoption of energy retrofit by households.

Barriers to sustainable retrofits. Even people who are interested and motivated in energy retrofits consider them to be a complex process. Households want a straightforward process, both technically and financially. Moreover, people expect the authorities to provide this step-by-step process for a hassle-free energy retrofit for households. Based on expert opinions, people asked questions about the cost, energy savings, loans/subsidies, type of energy retrofit, reliable contractors, and facilitation of the energy retrofit process in the decision-making phase.

The data suggest that municipal project managers and practitioners are aware of key transaction cost barriers. The main transaction cost barriers identified in energy retrofit programmes were (a) a lot of time and effort to find reliable information, (b) expensive energy-saving measures, and (c) the complexity of implementing energy-saving measures, e.g., due to structural reasons or living in an old building. In addition, they reported new transaction cost barriers, such as homeowners' uncertainty about national energy policies, e.g., the elimination of natural gas heating.

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