Homeowners' Participation in Energy Efficient Renovation Projects in China's Northern Heating Region

Ma, J.; Qian, QK; Visscher, H.J.; Song, Kun

DOI
10.3390/su13169037

Publication date
2021

Document Version
Final published version

Published in
Sustainability

sustainability

MDPI

Article

Homeowners' Participation in Energy Efficient Renovation Projects in China's Northern Heating Region

Jiefang Ma [1,*], Queena Kun Qian [1], Henk Visscher [1] and Kun Song [2]

[1] Faculty of Architecture and the Built Environment, Delft University of Technology, 2628BL Delft, The Netherlands; k.qian@tudelft.nl (Q.K.Q.); h.j.visscher@tudelft.nl (H.V.)
[2] School of Architecture, Tianjin University, Tianjin 300072, China; imsongkun@126.com
* Correspondence: j.ma-1@tudelft.nl; Tel.: +31-657-988-316

Abstract: In China's government-led energy efficient renovation of residential buildings, homeowners' participation refers to their involvement and engagement throughout the process. Lacking homeowners' participation has brought difficulties in the execution and financing of the projects. This paper explores the current situation of homeowners' participation and provides suggestions for optimization from three perspectives: the steps and procedures of the participation process, the composition of the working group responsible for contacting the homeowners, and the contents to be discussed during the process. The semi-structured interview and questionnaire results show that homeowners' participation is not adequate, and the current arrangement deviates from their expectations. Although most homeowners are positive towards government-led renovation and are enthusiastic about being involved, the process setup is not well-designed to let them fully participate. Moreover, their expectations and preferences are related to several factors. It can be concluded that relevant laws and regulations should be introduced to provide a basis for solving problems at the executive level, and homeowner associations should be established to serve as a channel of communication between homeowners and the working group. Designing targeted renovation and participation strategy is a necessity to minimize the communication efforts.

Keywords: energy efficient renovation; existing housing stock; renovation process; participation

Citation: Ma, J.; Qian, Q.K.; Visscher, H.; Song, K. Homeowners' Participation in Energy Efficient Renovation Projects in China's Northern Heating Region. *Sustainability* **2021**, *13*, 9037. https://doi.org/10.3390/su13169037

Academic Editor: Domenico Mazzeo

Received: 15 June 2021
Accepted: 9 August 2021
Published: 12 August 2021

1. Introduction

Household energy consumption accounts for 80% of the whole building sector in China [1]. Due to the loose energy efficiency standards in the past, the energy performance of the large existing housing stock in China is much more unsatisfactory than that of the new buildings. Energy consumption per building in China is 2–3 times higher than that of developed countries with similar climatic conditions, and buildings are less comfortable due to poor thermal performance and insufficient insulation [2]. To step towards a more sustainable building stock, China's central and local governments have been promoting energy efficient renovation of district-heated apartment buildings in urban areas. The major renovation of apartment buildings must be undertaken collectively. Thus, it has been implemented through a "top-down" model, in which central and local governments take charge of renovation projects and make the majority of the investment [3].

In government-led renovation projects in China, "participation" is used to describe homeowners' involvement and engagement in the planning, decision-making, operating, and managing process. There is no consistent definition of participation at the policy level in China; nevertheless, it generally refers to the interaction between homeowners and the "responsible agency", which is usually a working group commissioned by the local government. The working group should mobilize the homeowners to undertake the renovation, provide them with adequate and accurate information, and collect their opinions and feedback to determine and adjust the renovation plan. Meanwhile, the homeowners are expected to cooperate with the government. They will be asked if they

agree with the renovation plan, which may require them to adjust their behavior before, during, and after the renovation. For example, allowing exterior and interior construction work that may affect their daily life; removing personal belongings in the public space; agreeing to adopt heat metering, and learning how to use it, etc. In some cases, they need to bear part of the renovation cost. The renovation should only be carried out when the majority of the homeowners (usually about two-thirds) accept the proposed renovation plan.

The degree of homeowners' participation is positively related to the smooth implementation and the outcome of the project [4]. However, experiences in the past decade indicate that winning homeowners' cooperation and unifying their opinions is difficult because they have different considerations about the renovation [4]; moreover, their willingness to invest in renovation is relatively low [5,6]. Homeowners tend to be resistant when the renovation affects their interests or when they feel they have been mistreated [7]. Therefore, the working group members will not have permission to charge fees from the homeowners, nor can the construction team enter private homes for necessary installation or maintenance work. Thus, the working group must compromise on the renovation plan to reach the required supporting ratio, and the depth of renovation projects cannot be ensured. On the other hand, when homeowners have questions or opinions, they do not know whom to speak to and whether their concerns would be taken seriously, which weakens their willingness to participate. Consequently, homeowners can only participate in the renovation partially and passively. The participation cannot serve its intended purpose, which has seriously hindered the renovation progress and increased the government's financial burden.

In recent years, several documents released by China's central and local governments have brought up the importance of homeowners' participation. As the Guideline for Energy Efficient Renovation in Residential Buildings [8] mentioned, "The energy-saving renovation of existing residential buildings involves multiple subjects such as households, housing property units, heating units, etc. In particular, the implementation of the renovation requires the understanding, support, and cooperation of residents, and has many particularities". In a recent document published by the State Council [9], the necessity to establish a sound organization and implementation mechanism is also highlighted: "...various forms of discussion and negotiation should be organized to understand the demands of the residents and to seek consensus; residents should be encouraged to actively participate in different stages of the process, including the designing, the construction, the supervision, the post-renovation management and evaluation, and to give their feedback".

Such initiatives can only be realized when the actual situation of homeowners' participation is given enough attention and comprehensively understood. Although people have different opinions about what an ideal process would be like, it goes without doubt that a process that meets their expectations will be more attractive. Under this presumption, the process should be improved to better tap into homeowners' expectations.

Some previous studies have investigated energy efficient renovation in China by evaluating the energy-saving potential [10], exploring the economic sustainability and proposing an optimum financing plan [11,12], designing the incentive mechanism for the local government and the market [13], investigating the stakeholders' risk perception [14], and identifying the quality failures in renovation projects [15]. However, few studies have addressed homeowners' participation.

This study aims to fill in the gap by investigating the current nature of homeowners' participation in energy efficient renovation projects in China's Northern Heating Region. We conducted semi-structured interviews and used a questionnaire survey to collect opinions and empirical evidence. The study tries to answer the following questions: (1) Currently, how do homeowners participate in renovation projects? (2) What are homeowners' expectations for their participation, and how do the expectations deviate from reality? (3) How can the participation process be optimized to increase homeowners' participation?

The content of the paper is organized as follows: Section 2 gives an introduction of energy efficient renovation of residential buildings in China's Northern Heating Region,

and reviews global literature about homeowners' participation in apartment building renovation projects; Section 3 introduces the methodology and survey design; Section 4 presents the results; Section 5 offers a discussion out these results and produces recommendations, while Section 6 gives conclusions.

2. Literature Review

2.1. Government-Led Energy Efficient Renovation Projects in China's Northern Heating Region

China's Northern Heating Region covers the severe cold zone and cold zone. The region consists of 15 provinces and municipalities [16]. In this region, buildings should meet the requirements of heat insulation and anti-freeze in winters.

Technical measures suitable for the Northern Heating Region include (1) upgrading building envelope, e.g., insulating external walls, roofs, and balconies, replacing low energy efficient windows and doors, etc.; (2) upgrading heating supply system, e.g., heating source, coal-fired boiler; (3) maintaining or replacing heating pipes to increase the energy efficiency; (4) adopting heat metering system; (5) adopting indoor heating control system. These measures aim at reducing energy consumption and improving indoor comfort levels during the heating seasons from November to March in most provinces.

In the Northern Heating Region, the main target of housing energy efficient renovation is multi-floor private-property apartments built before the 2000s in the urban area [8]. The majority of apartment buildings in China are organized and governed as residential communities with clear territorial spaces [17]. A typical residential community comprises several apartment buildings with large population density and small mobility [18].

As a result of housing privatization in urban China since the 1990s, the property of each unit in the apartment belongs to a different homeowner, which appears to be an obstacle in the renovation. For example, if an individual homeowner is unsatisfied with the living condition and intends to renovate his/her home, he/she can only make some minor changes to the unit, such as replacing old windows with bridge-cut aluminum alloy windows. Deep renovation must be carried out to the apartment building as a whole, for all homeowners share the ownership of public spaces.

The mandatory regulations were only given to the total floor area and the energy performance instead of the process and the degree of homeowners' participation. A large scale of renovation has been carried out in the past decade, but a higher level is optimal. By the end of the 14th "Five-Year Plan" period (2021–2025), all the existing residential buildings built before the 2000s should have been renovated [9]. Apart from the commonly applied renovation measures, more state-of-the-art technologies should be applied in practice, such as adopting intelligent technologies, the use of renewable energy, and the monitoring of energy consumption after renovation [19].

The implementation of these renovation measures demands homeowners' participation for several reasons. Firstly, the construction work will influence homeowners' daily lives, and the outcomes of the renovation will also bring changes to their property. Secondly, homeowners are expected to invest in the projects as the direct beneficiary of the renovation because they can benefit from reduced energy bills and increased property value after renovation. Thirdly, to maximize the effect of renovation measures, homeowners need to understand their working principles and operation methods fully. Therefore, reaching an agreement with homeowners is particularly crucial.

Since no bottom-up governance structures are specified in governmental regulations, the organizing of homeowners' participation in renovation projects is often carried out by a working group under the governments' commission. As suggested by the Guideline for Energy Efficient Renovation in Residential Buildings [8], the working group should approach the homeowners to finish the following tasks: investigating homeowners' information, collecting their demands, and informing them about the renovation; inviting homeowners to discuss the renovation plan; signing contracts and charging fees; solving issues that may arise during the construction; teaching homeowners to use the energy-saving facilities properly.

However, compared to making minor renovations on their initiative, homeowners are less willing to cooperate in projects involving the coordination of multiple residents [20]. They consider the apartment unit to be their home instead of the whole building [21]. Furthermore, being unable to broker an agreement with all homeowners makes it difficult to arrange financing matters [20]. Some are unwilling to pay because they believe other stakeholders should be responsible for investing [5]. Others may find the investment to be financially unattractive [22]. Correspondingly, the difficulty of gathering sufficient expenditure and implementing renovation measures is increased.

2.2. Homeowners' Participation in Apartment Building Renovation in Other Countries and Regions

Renovation of apartment buildings is usually carried out under the cooperation of multiple actors, such as energy-providing companies, banks, construction engineering and supplying companies, municipalities, associations, policy implementing authorities and agencies, and policy-making authorities [23]. In countries and regions where apartment buildings are highly privatized, homeowners can be involved to different degrees, from being informed to being part of decision-making [24].

Launching the renovation process depends on the general approval of all the homeowners. Thus, a few active "saboteurs" who are against the renovation can successfully cause other homeowners' doubt, and it takes a long time for experts or fellow homeowners to convince and persuade them [21]. To obviate the obvious difficulty, in Lithuania, the local authorities will present homeowners with theoretic evaluations that are far from the actual situation, making them overestimate the effect of the renovation [25]. In Moscow, municipal administrations tend to conceal the actual technical state of the building to avoid the expenditure of resettling the residents [26]. On the one hand, these solutions intensified the homeowners' distrust of the local authority; on the other hand, they imposed risk to the homeowners.

Lacking homeowners' participation in renovation projects has correspondingly increased the difficulty of gathering sufficient expenditure and implementing renovation projects. For instance, in the Moscow housing program, the residents were not involved in financing, and thus all the costs of implemented building renovations had to be covered by the budget of the City of Moscow [27]. Chileshe [28] concluded that lacking consultation between the service providers and contractors with the residents would be the most significant barrier affecting home renovation in the future.

Some studies suggested that homeowners should be involved at specific times throughout the process. Mirakyan and De Guio [29] developed a generic integrated energy planning procedure of cities and territories in which the planning activities are divided into four main phases: preparation and orientation, detailed analysis, prioritization and decision, and implementation and monitoring. In their opinion, the general public can be involved in the third phase, prioritization and decision, during which workshops should be organized for multiple interested stakeholders to compare options and select strategies. Pedersen [30] suggested that residents be considered partners in renovation decisions, and measures that impact homes—such as overall intention, reasons and planning, and craftsmen's activities—should be explained to and supported by the residents.

Due to homeowners' bounded rationality, their reactions can differ when different actors deliver the same information. Moreover, because of the uniqueness and uncertainty of projects, the outcome of non-standardized customer interaction will be more dependent on the service provider's personnel. Thus, actors who deliver relevant information to homeowners may directly affect the implementation of renovation projects. Interaction between actors creates an informational environment in which information is not precise and objective [23], making residents' decisions deviate from theoretical models. Högberg [31] suggested that the differences between real estate companies and managers should be considered in the policymaking of renovation, for different types of people have different attitudes and mindsets. Holm [32] argued that home renovation should belong to the service industry; thus, customer satisfaction is necessary. Paiho [27] mentioned that the

investors of renovation projects could partner with local authorities to keep the residents informed, which may help overcome the obstacle caused by apartment owners' distrust.

2.3. Homeowners' Participation in Energy Efficient Renovation Projects in China's Northern Heating Region

2.3.1. Steps and Procedures of Renovation Projects

Unsure about or disagree with the renovation procedure is a significant reason for Chinese homeowners to be reluctant to renovate [33]. The only instruction given as a reference for arranging work about homeowners' participation is in Chapter 3: Communicate with Residents, Guideline for Energy Efficient Renovation in Residential Buildings [8] issued by MOHURD (the Ministry of Housing and Urban-Rural Development) (see Figure 1).

According to the instruction, when the government makes renovation decisions, a working group should be formed to inform the homeowners. Working group should first be trained, and take responsibility for several actions, e.g., investigate homeowners' profile, including their household composition, living condition, and attitude towards renovation; invite homeowners to discuss the renovation plan; sign agreements with homeowners and charge them; educate homeowners to use and maintain new energy efficient facilities. The communication and negotiation should go several rounds to ensure that homeowners are fully informed. This guideline does not specify which agency should form the working group and arrange homeowners' participation.

In this guideline, it is suggested that a project can be executed if 75% of homeowners agree on the program and sign the agreement. However, the instruction is not mandatory, and to our knowledge, there are no statistics about whether the process is executed in real situations.

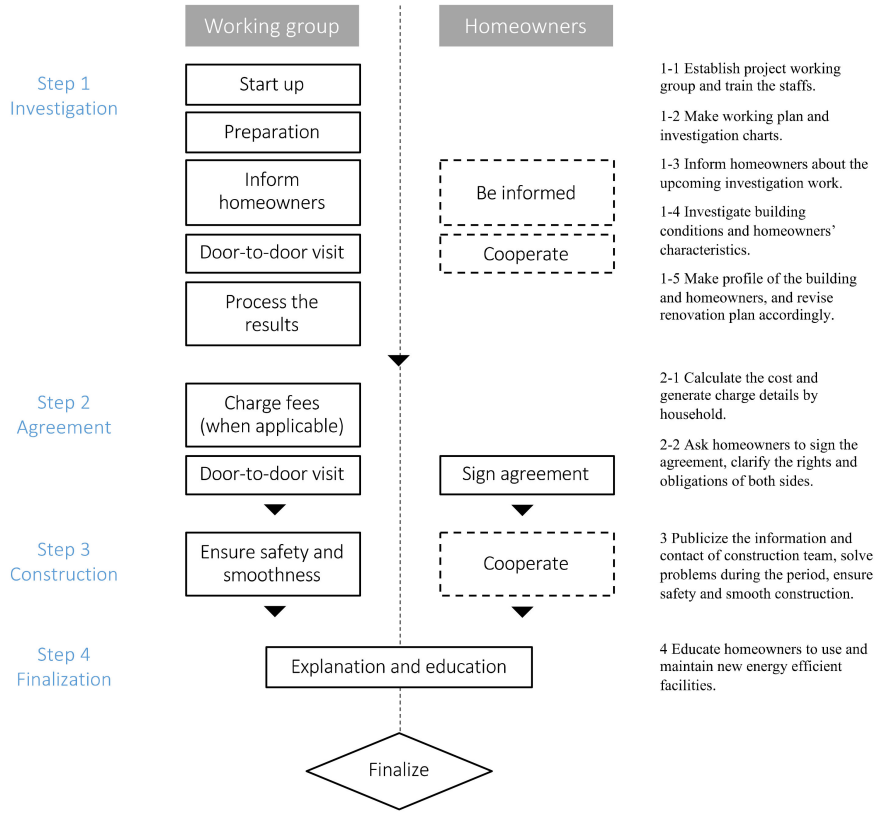

Figure 1. Instruction for homeowners' participation (The Ministry of Housing and Urban-Rural Development, 2012). Texts in the dashed border means homeowners' role in these steps is passive.

2.3.2. Composition of Working Group

In China, the resolution of residential community management affairs mainly relies on the interaction among neighborhood committees, property management companies, homeowners' committees, and individual homeowners [34]; an active and efficient responsibility mechanism for homeowners' participation has not been established. Homeowner associations only emerged very recently in China and have not been widely promoted or standardized—even in many big cities, it has only been established in around 20% of residential communities by 2014 [35], and there are significant discrepancies in its ability and effectiveness to deal with problems [36]. If a conflict or dispute occurs, the neighborhood committee would usually become the critical coordinator and mediator, and deliberation has been the primary instrumental tool for conflict resolution [37]. However, neighborhood committees' role is limited to daily affairs; they are not empowered to make crucial decisions and manage essential issues.

Some domestic studies have found that, apart from homeowners, some stakeholders can play a role to communicate with homeowners in the governance of residential communities, such as municipal governments, urban planning bureaus, legal affair offices, subdistrict offices (Chinese: 街道办事处), and non-governmental organizations [38,39]. Nevertheless, it is not specified which actors might be involved in the working group and be responsible for arranging homeowners' participation in energy efficient renovation. In other words, to our knowledge, we do not know who is responsible for contacting the homeowners in actual energy efficient renovation projects. It is also unknown whether they can deliver necessary information efficiently to the homeowners.

2.3.3. Contents of the Discussion

The contents of the discussion between homeowners and the working group members are also important. The MOHURD guideline suggested that the following content should be clarified in the agreement: renovation measures, charges and fees, construction period and time, rights and obligations, removal plan of illegal structure, and other necessary matters.

- Renovation measures describe the technique measures carried out in the project, generally including the construction of doors and windows, external walls, roofs, and heat supply system. It will directly influence how the project will be carried out and what outcome shall be expected.
- Charges and fees clarify whether homeowners need to pay for the renovation, and if so, what is the financial plan. Currently, in most cases, homeowners do not pay for the renovation.
- Construction period and time will determine the extent to which homeowners' daily life is affected. Compared to the construction of newly built buildings, the renovation project's construction work is carried out with more constraints. For example, the construction period is shorter, the site's conditions are often more complicated, and the construction work is more dependent on the weather.
- It is not specified in the guideline that what rights and obligations homeowners have. During the participation process, the rights and obligations of both sides should be discussed and clarified.
- Many target buildings have poor conditions, and residents would build some illegal structures to improve their original homes' living functions. These structures include canopies, storage rooms, and balconies. In some cases, residents have been using their homes for small businesses and have added illegal neon lights or signboards. The removal plan of the illegal structure must be discussed; otherwise, it may cause conflicts if these structures need to be demolished during the renovation.

3. Methodology

The data collection process of the paper is organized as follows. Interview and questionnaire surveys were used in this study. Firstly, interviews were conducted to gather detailed information on the actual implementation of renovation projects. Some interviewees were interviewed individually, and others are from three representative renovation cases in the Northern Heating Region. A questionnaire was designed and disseminated by both hard copies and an online survey website based on the interview findings (see Appendices A and B).

3.1. Semi-Structured Interview

A total of 47 participants were interviewed (see Table 1). The interview was semi-structured. Interviewees were encouraged to share all their opinions towards renovation projects.

Table 1. Overview of interviewees.

Occupation	Number	Description
Researcher	8	Researchers specialized in the research of building renovation, urban renewal, and sustainable housing.
Government employee	4	Staff from urban planning and housing authority departments of the local government.
Architect	8	Staff from architectural design institutes who have participated in design process of renovation projects.
Energy company employee	2	Staff from energy supply companies who are responsible for market research and policy research.
Project manager and contractor	3	Members of construction management teams who are responsible for contract designing and implementing.
Neighborhood committee member	7	Members of neighborhood committees from three residential communities (2 in Tianjin/1 in Beijing) that had been renovated.
Property management company employee	3	Staff of property management companies from three residential communities (2 in Tianjin/1 in Beijing) that had been renovated.
Homeowner association member	12	Members of homeowner associations from three residential communities (2 in Tianjin/1 in Beijing), representative of homeowners who have undertaken renovation.

Three renovated residential communities in Tianjin and Beijing were selected as representative cases (see Figure 2). Neighborhood committee members, property management company employees, and homeowner association members from these three cases were interviewed, engaging 22 interviewees. Tianjin and Beijing are among the leading cities of energy efficient renovation. All three cases were renovated under the local government-led model. The renovation of residential communities is usually not carried out to all buildings together. Therefore, homeowners interviewed are either from renovated or un-renovated buildings. To avoid biases related to the interviewee selection, we selected three residential communities with different features, such as the scale of the community, the total floor of the buildings, the year of building, and the adopted renovation measures. The detailed information of all three cases is presented in Table 2.

Figure 2. Examples of residential communities in China's Northern Heating Region (screenshots of Baidu Maps). The screenshots show three residential communities that are similar to cases A, B, and C, respectively.

Table 2. Profile of cases.

Case	A	B	C
Location	Tianjin	Tianjin	Beijing
Year of building	1990	2000	1982
Year of renovation	2017	2014	2013
Number of households	1120	1850	2400
Number of buildings	9	15	30
Total floor area (m^2)	50,800	160,000	108,000
Total floor	7	13	6
Renovation measures	Pipeline maintenance, external wall insulation, roof insulation	Window replacement, heat metering	Pipeline maintenance, external wall insulation, roof insulation, window replacement, heat metering

A further 25 interviewees were practitioners who took part in renovation projects, such as government employees, construction managers, architects, energy company employees, and researchers who specialized in relevant research domains. The access to these interviewees was achieved through social networks, as they were asked to suggest potential participants when the interview finished.

Interviewees were asked to introduce some basic information about themselves initially, e.g., their personal opinions towards energy efficient renovation. The interview's body mainly includes the following topics: steps and procedures of renovation, commonly applied technical measures, communication with homeowners, and negotiation with homeowners. They are also encouraged to share opinions on other aspects of the renovation. The knowledge obtained by interviews will be used for questionnaire design.

3.2. Questionnaire Survey

A total of 500 hard copies were sent to homeowners directly by person in several key areas for energy efficient renovation in the Northern Heating Region, namely Beijing municipality, Tianjin municipality, Hebei province, and Heilongjiang province. Overall, 185 valid questionnaires were collected through this approach. Meanwhile, 294 valid responses were collected from unpaid anonymous respondents in all the provinces and municipalities in the Northern Heating Region through an online survey website, "wenjuanxing (Chinese: 问卷星)". Thus, the total amount of sample in this study was $N = 479$.

In the questionnaire, respondents were asked to assume that they face an actual government-led energy efficient renovation in their apartment. They needed to indicate whether they would like to undertake the renovation and answer questions about their preferences and expectations regarding the composition of the working group and the content discussed during the participation process. Respondents also needed to indicate whether their apartment had been renovated. Those who had undertaken renovation will need to finish another set of questions about details of their experiences. The order of

options in the body of the questionnaire was randomly displayed. By the end of the survey, respondents would need to provide their demographic profiles. They are also encouraged to provide any further concerns in a free comment space.

Table 3 gives a summary of the socio-demographic characteristics and buildings features of the sample. We collected respondents' gender, age, occupation status, highest education level, and annual household income to investigate how these factors are related to homeowners' willingness to participate. Since the target buildings of energy efficient renovation are similar in many building conditions, such as building age, location, and energy performance, we only collected the following features: the total floor of the building and the floor area of the unit.

Table 3. Socio-demographic characteristics and building features of the sample.

Variable	Classification	Percent (%)
Gender	Male	51.8
	Female	48.2
Age	30 and below	45.8
	31–50	31.1
	51 and above	23.1
Occupation status	Student	20.7
	Full-time worker	59.3
	Unemployed/retired	19.3
Highest education level	College and below	30.2
	Undergraduate	42.2
	Postgraduate and above	27.6
Annual household income (CNY *)	100,000 and below	51.7
	100,001 to 200,000	27.6
	200,001 and above	20.7
Total floor of building	6 floors and below	48.6
	7 floors and above	51.4
Floor area of unit	50 m^2 and below	20.4
	51 m^2 to 90 m^2	35.6
	91 m^2 to 120 m^2	24.2
	121 m^2 and above	19.8

* 1 CNY (Chinese Yuan Renminbi) ≈ EUR 0.125.

Apart from the above-mentioned factors, a large body of research has identified the influence of behavioral factors on homeowners' energy-related decisions. These factors can give a new perspective to analyze the reasons for homeowners to make decisions [40]. Existing applied behavioral research on energy efficiency mainly focuses on individual homeowners who can take the initiative to renovate their own homes. It remains unknown if homeowners' decisions to participate in government-led renovation projects are also subject to these factors. Thus, behavioral factors that seem applicable in the government-led renovation were included in the questionnaire.

As shown in Table 4, it can be concluded that respondents are not very satisfied with their indoor comfort level and do not reflect a great interest in general environmental protection issues. Meanwhile, the approval level for energy efficient renovation is relatively high. Most respondents have at least some knowledge about the renovation. About half of the respondents thought the renovation should be promoted and encouraged, indicating a very positive attitude. Furthermore, 112 respondents finished Section 4 of the questionnaire, indicating they had undertaken government-led energy efficient renovation.

Table 4. Behavioral factors of the sample.

Variable	Classification	Percent (%)
Satisfaction of indoor comfort	Dissatisfied	23.7
	Fair	67.7
	Very satisfied	8.6
Awareness of environmental protection issues	Unconcerned	32.1
	General concerned	54.8
	Very concerned	13.1
Knowledge of energy efficient renovation	Not at all	15.8
	Heard about it	47.7
	Clearly understand the meaning	36.5
Attitude towards energy efficient renovation	Neutral or negative	6.8
	Positive	47.3
	Very positive	46.0
Experience of renovation	No government-led renovation experience	19.4
	Have government-led renovation experience	80.6

4. Results

4.1. Interview Results

4.1.1. Steps and Procedures

Firstly, interviewees were asked to provide comments on the steps and procedures of renovation after reviewing the instruction for homeowners' participation from Chapter 3: Communicate with Residents, MOHURD Guideline (see Figure 3). It demonstrated an ideal procedure for how homeowners can be involved in the renovation project's whole process.

It was generally agreed that the given instruction is reasonable. However, interviewees suggested several aspects that could be improved. Based on the suggestions above and other opinions from the interviewees, an improved workflow is proposed in Figure 3.

The main idea is to create opportunities for homeowners to be actively involved in the process. In the investigation step, after informing homeowners about the upcoming work, the working group should organize events to give a detailed explanation about the renovation measures and technique terms to homeowners, such as seminars of pilot project visit. It may also be helpful if the working group can present several renovation alternatives to homeowners with different costs and outcomes and formulating guidelines for homeowners with clear and simple contents. After investigating each household's exact condition, followed by several rounds of discussion and feedback, the working group should let homeowners confirm the proposal before starting to charge fees and sign the agreement.

Another part of improvement is the finalization step, during which the working group should teach homeowners to use the new energy-saving facilities. According to interviewees' opinion, it should start with confirming the successful adoption of all the renovation measures to ensure effectiveness and safety. Homeowners' ability to properly use the new facilities is critical for the renovation effect, for some of the facilities can only work when homeowners' energy use behaviors are adapted. Thus, a follow-up survey is essential, making it possible to observe homeowners' behavior change after renovation.

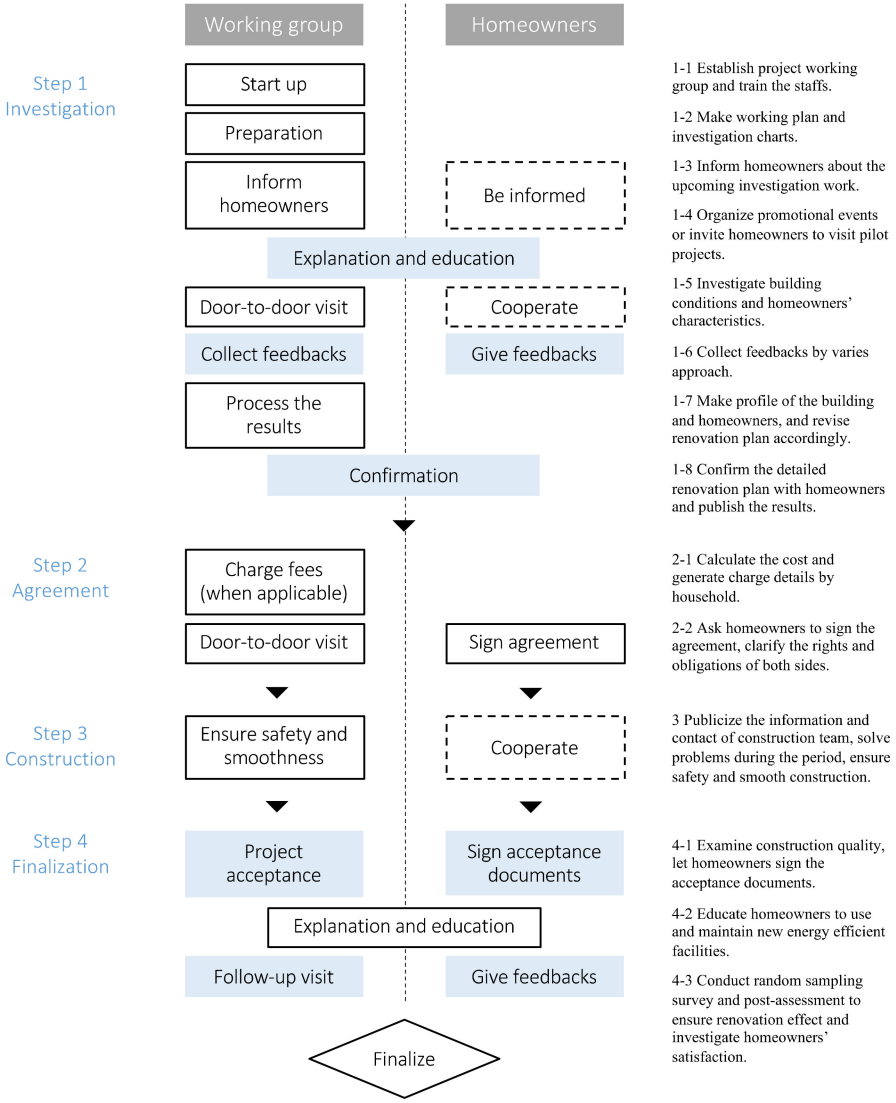

Figure 3. Phases and steps of homeowners' participation (improved based on interview results). Added items are shown in the color-filled blocks.

4.1.2. Composition of Working Group

Through the interviews, we concluded that the working group is mainly composed of government employees, neighborhood committee members, energy company employees, and property management company employees. Hence, these four categories formed the options in the questionnaire as we asked who had been in charge of the communication.

In most cases, government employees are the leader of the working group. Most of the practitioners and researchers believed that homeowners trust them more than people from other agencies. They also believed that neighborhood committee members are more familiar with homeowners' daily lives, making them more suitable for mediating contradictions during the negotiation process. In projects involving the renovation of heating systems, such as heat metering and replacing heat pipes, energy company employees are responsible for explaining some necessary details, including how the construction will occur and how to calculate the heating cost after renovation. Property management company employees are often responsible for charging fees and taking on other specific works.

4.1.3. Contents to Be Discussed

Based on the instructions in the MOHURD Guideline and interviewees' suggestions, the following contents were identified to be discussed during the communication with homeowners: renovation measures, financial plan, time plan, construction plan, maintenance methods, contractor, construction team, and material. Some are already included in the MOHURD Guideline or are adjusted from items in the Guideline; some others are proposed by the interviewees. A comparison of these items is shown in Table 5.

Table 5. Content to be discussed, comparing instructions in the MOHURD Guideline and interview results.

	MOHURD Guideline	Interview Results
Same	Renovation measures	Renovation measures
Adjusted	Charges and fees	Financial plan
Split and combined	Construction period and time	Time plan
	Removal plan of illegal structure	Construction plan
Added	N/A	Maintenance methods
	N/A	Contractor
	N/A	Construction team
	N/A	Material
Deleted	Rights and obligations	N/A

"Renovation measures" describes the combination of technical measures listed by the MOHURD Guideline, which is obviously necessary to be discussed. "Charges and fees" is adjusted into "financial plan", which describes the extended negotiation about the financial issues, such as whether the cost can be paid by installments, and how the residents in the same apartment could split the bill. "Construction period and time" and "removal plan" can be restructured into "time plan" and "construction plan". Apart from the above, interviewees suggested some new items: "maintenance methods", "contractor", "construction team", and "material". "Material" specifies how the renovation will be carried out. "Financial plan", "contractor" and "construction team" are about the arrangement of funding and staffing. "Maintenance methods" includes two aspects: how professional workers maintain the new energy-saving facilities and how homeowners can use them properly. Interviewees suggested removing "rights and obligations", because the rights and obligations of both sides should already be clearly defined at the policy level. If these cannot be made mandatory, there will be room for conflicts in practice.

4.2. Questionnaire Results

4.2.1. Homeowners' Willingness to Participate in Energy Efficient Renovation

Homeowners' intention to undertake government-led energy efficient renovation is shown in Figure 4. A total of 84.1% of respondents would like to undertake government-led renovation, among which 46.2% would agree to bear (part of) the cost. Furthermore, 15.9% gave negative responses because they would instead take the initiative and carry out the renovation themselves or do not want to renovate.

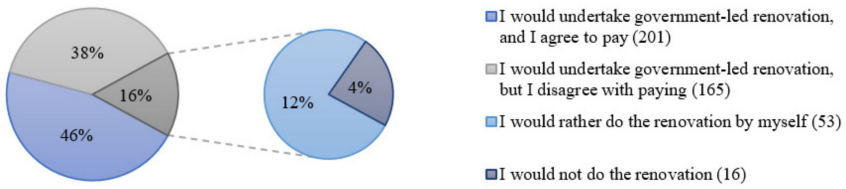

Figure 4. Homeowners' intention to undertake government-led renovation (N = 435).

4.2.2. Homeowners' Expectations and Experiences in Energy Efficient Renovation

In this part, all respondents are asked to indicate their expectations about the following two aspects: composition of the working group and content of the discussion. Those who have undertaken renovation need to answer a further question about their experiences in real projects. The setup of questions makes it possible to compare the ranking among homeowners' expectations based on respondents' vote and ranking in an actual situation based on the report of those who have undertaken renovation and explore to what extent the actual situation deviates from homeowners' expectations. The answers are collected by multiple-choice questions: based on their experiences and expectations, respondents can choose any combination of the options freely or choose none of them if nothing suits them.

Composition of the Working Group

As shown in Table 6, a total of 94 respondents that have undertaken renovation answered this question; 46 indicated that they had been approached by government employees in the working group (48.9%) and 44 mentioned neighborhood committee members (46.8%). Energy company employees (34.0%) and property management company employees (24.5%) also contributed to renovation projects.

Table 6. Composition of the working group in actual projects indicated by homeowners who have undertaken government-led renovation (*N* = 94).

	Times Chosen	**Percent (%)**
Government employees	46	48.9
Neighborhood committees	44	46.8
Energy company employees	32	34.0
Property management company employees	23	24.5

The expectation of all respondents about the same issue is shown in Table 7. Of the 465 respondents who answered this question, 325 (69.9%) preferred to have government employees in the working group. The main difference from the observation of reality lies in the other three groups. Neighborhood committee members rank the last in homeowners' expectations: only 29.9% expected to discuss with them.

Table 7. Homeowners' expectation about composition of the working group (*N* = 465).

	Times Chosen	**Percent (%)**
Government employees	325	69.9
Energy company employees	226	48.6
Property management company employees	153	32.9
Neighborhood committees	139	29.9

On the other hand, respondents indicated a request for communicating with energy company employees (48.6%) and property management company employees (32.9%). Some respondents also suggested involving architects, craftsmen, and other professional people in the discussion through the questionnaire's free feedback space. The above attitude reflects homeowners' demand for specific knowledge about the renovation. Comments collected from the free feedback space also showed that some homeowners find none of these working group members trustworthy. They expect someone who can stand on their side and speak for them as a representative of homeowners.

A comparison of the actual situation and homeowners' expectations is shown in Figure 5. The results reflect homeowners' expectations to have more chances to receive professionals' suggestions. From the homeowners' perspective, the most valuable part of communication is understanding and learning, rather than being informed and being persuaded.

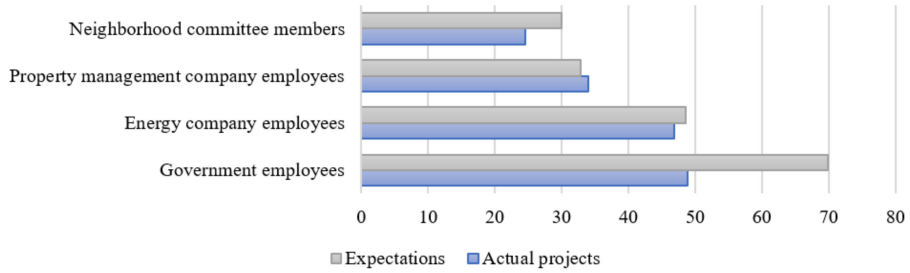

Figure 5. Composition of working group, comparing actual projects and homeowners' expectations by percentage.

Contents of the Discussion

In the questionnaire, apart from the items from the list in the MOHURD Guideline, we added two options for those who thought they had not been informed with enough information: "agree or not" means they had only been asked whether they agree on the pre-set plan, and "not been informed at all" indicates that they have not been involved in the process and no one has ever contacted them by any means. The two options are added because the interviews of practitioners revealed that the agreement procedure was skipped in some projects. Since door-to-door discussion is a time-consuming process, in many cases, it was considered as completed after working group had talked with homeowner representatives or had posted an announcement poster in the residential community. Homeowners can choose all the options that suit them; thus, the sum of the percentages is above 100%. The results are shown in Table 8.

Table 8. Content of the discussion in actual projects indicated by homeowners who have undertaken government-led renovation (N = 99).

	Times Chosen	Percent (%)
Not been informed at all	42	42.4
Renovation measures	37	37.4
Financial plan	29	29.3
Material	24	24.2
Time plan	19	19.2
Maintenance methods	17	17.2
Contractor	14	14.1
Agree or not	14	14.1
Construction plan	10	10.1
Construction team	7	7.1

Although the MOHURD Guideline highlighted that homeowners should be informed, 42.4% of respondents indicated they had not been involved. Another 14.1% of respondents indicated they were asked to sign the agreement with a default plan and did not participate in the itemized decision-making.

The rest of the respondents mainly had participated in the discussion of "renovation measures" (37.4%), "financial plan" (29.3%), and "material" (24.2%). The difference between other options is not significant: "time plan" (19.2%) describes the schedule of the project, "maintenance methods" (17.2%) includes teaching homeowners how to use the new facilities and setting future maintenance plan, "contractor" (14.1%), and "construction team" (7.1%) refers to the selection of agencies, and "construction plan" (10.1%) describes the detailed construction plan, e.g., the arrangement of scaffolding, indoor construction, power cut, etc.

Respondents' expectations about content to be discussed indicated their strong willingness to share their opinions on all aspects of the renovation (see Table 9. Each respondent had chosen an average of four items, while those who had actual experiences were involved

in only 1.7 on average. Apart from this, differences exist in homeowners' preferences to take part in the discussion towards each specific item.

Table 9. Homeowners' expectations about content to be discussed (N = 472).

	Times Chosen	Percent (%)
Renovation measures	345	73.1
Financial plan	279	59.1
Time plan	261	55.3
Maintenance methods	261	55.3
Material	252	53.4
Construction plan	198	41.9
Construction team	121	25.6
Contractor	118	25.0
Agree or not	65	13.8
Not been informed at all	32	6.8

First of all, only 6.8% of respondents would not like to be involved at all, and 13.8% would like only to be asked whether they agree on the current plan. Reasons may be being afraid of hassle or having completely no knowledge about the renovation.

As shown in Figure 6, "renovation measures" (73.1%) and "financial plan" (59.1%) remain the most concerned items, followed by "time plan" (55.3%), "maintenance methods" (55.3%), and "material" (53.4%). The interest in "construction plan" (41.9%), "construction team" (25.6%), and "contractor" (25.0%) remains relatively lower.

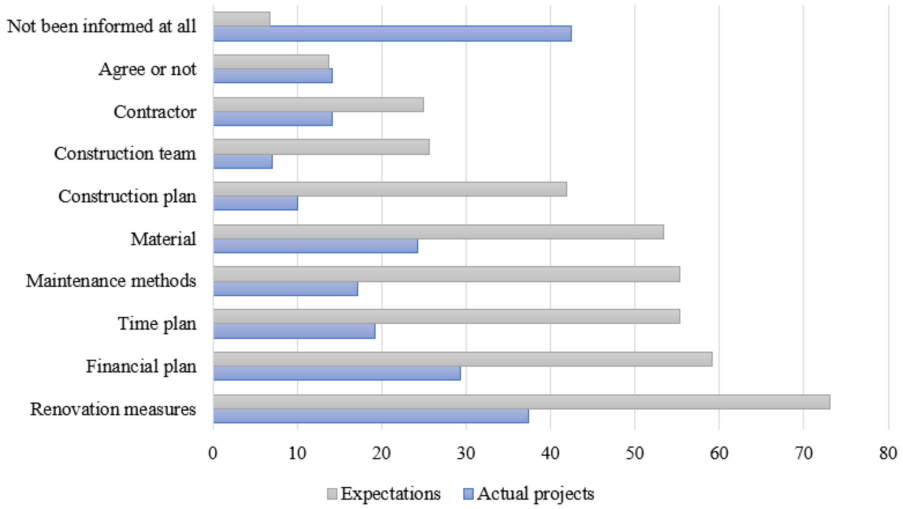

Figure 6. Content to be discussed, comparing actual projects and homeowners' expectations by percentage.

4.2.3. Factors Influencing Homeowners' Expectations

In this part, using crosstabs and a chi-square statistic, we explored the difference in homeowners' expectations about participation among different groups of people. The goal is to investigate whether socio-demographic characteristics, building features, and behavioral factors varied with homeowners' expectations. The findings can provide evidence for the working group to design targeted strategies to improve homeowners' participation.

The dependent variables include homeowners' preferred working group members and their intention to participate in the discussion. All the dependent variables are binary (yes = 1, no = 0). Regarding the independent variables, all of them are formed by mutually exclusive categories. Therefore, the data meet the specific assumptions of the chi-square test of independence. There is no chi-square result in which more than 20% of cells have an expected count of less than five, indicating a satisfying sample size.

The results of the non-parametric analysis are shown by three categories, with 12 sets of independent variables (see Table 10):

- Socio-demographic characteristics:

  G: gender of respondent;
  A: age range;
  Occ: occupation status;
  Edu: highest education level;
  Inc: annual household income.

- Building features:

  F: total floor of building;
  FA: floor area of unit.

- Behavioral factors:

  S: satisfaction of indoor comfort;
  Aw: awareness of environmental protection issues;
  Kl: knowledge of energy efficient renovation;
  Att: attitude towards energy efficient renovation;
  R: having renovation experience or not.

The abbreviations in the first column of the table refer to working group members and aspects of discussion:

c-G: government employees;
c-EC: energy company employees;
c-PMC: property management company employees;
c-NC: neighborhood committee members;
d-RM: renovation measures;
d-FP: financial plan;
d-C: contractor;
d-CT: construction team;
d-TP: time plan;
d-CP: construction plan;
d-M: material;
d-MM: maintenance methods.

Table 10. Comparison of homeowners' intention to discuss among variables. The complete results are attached in Appendix B.

	Socio-Demographic Characteristics					**Building Features**		**Behavioral Factors**				
	G	**A**	**Occ**	**Edu**	**Inc**	**F**	**FA**	**S**	**Aw**	**Kl**	**Att**	**R**
c-G	0.004 **	0.235	0.188	0.355	0.123	0.788	0.398	0.377	0.380	0.203	0.374	0.698
c-EC	0.372	0.026 *	0.013 *	0.760	0.890	0.687	0.955	0.045 *	0.118	0.314	0.117	0.498
c-PMC	0.569	0.005 **	0.007 **	0.002 **	0.596	0.458	0.275	0.674	0.003 **	0.026 *	0.019 *	0.418
c-NC	0.604	0.031 *	0.185	0.195	0.354	0.251	0.030 *	0.140	0.394	0.368	0.580	0.034 *
d-RM	0.523	0.010 *	0.051	0.062	0.214	0.361	0.135	0.160	0.020 *	0.068	0.112	0.218
d-FP	0.767	0.231	0.255	0.023 *	0.145	0.156	0.678	0.744	0.342	0.073	0.013 *	0.223
d-C	0.334	0.008 **	0.098	0.002 **	0.047*	0.151	0.274	0.278	0.217	0.589	0.454	0.074
d-CT	0.235	0.424	0.476	0.040 *	0.112	0.802	0.030 *	0.404	0.710	0.200	0.810	0.054
d-TP	0.059	0.012 *	0.022 *	0.000 ***	0.006 **	0.601	0.838	0.432	0.085	0.692	0.071	0.058
d-CP	0.112	0.172	0.158	0.061	0.013 *	0.724	0.911	0.093	0.227	0.539	0.007 *	0.178
d-M	0.403	0.060	0.569	0.000 ***	0.226	0.601	0.841	0.279	0.083	0.022 *	0.239	0.078
d-MM	0.528	0.324	0.037 *	0.004 **	0.034 *	0.738	0.665	0.352	0.345	0.871	0.041 *	0.809

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

For the independent variables with more than two categories, if the chi-square test results indicate a statistical significance (p-value < 0.05), we conducted a post-hoc test using Bonferroni correction to determine which specific groups are statistically significantly different from each other.

About the composition of the working group, homeowners generally agree on government employees, energy company employees, and neighborhood committee members. The differences are mainly concentrated on whether to involve property management company employees: they are not preferred by homeowners that are elder or have a lower education level and those who spend more time at home because of unemployment or retirement. Meanwhile, they are relatively more welcomed by homeowners who hold a neutral or fairly good attitude towards environmental protection issues and energy efficient renovation and have some relevant knowledge.

Furthermore, compared to younger homeowners, the elder group (51 and above) prefers neighborhood committee members instead of energy company employees. Gender difference does not predict most of the dependent variables, except male homeowners tend to include government employees in the working group.

Homeowners' gender, their satisfaction of indoor comfort level, renovation experiences, and the total floor of the building is not significantly related to any discussion aspect. Homeowners will be more likely to be willing to participate in the discussion if they are relatively young, are currently under education, or have a higher education level as well as a higher income level. The intention to be involved in the discussion of the renovation measures, financial plan, construction team, construction plan, material, and maintenance methods can be predicted by certain building features or behavioral factors.

Different socio-demographic groups have the most significant deviation in time plan and maintenance methods when analyzed by decision items. The former is more concerned by the following groups: young people, students, full-time workers, and homeowners with a higher education level (at least university degree) and higher income (annual household income more than CNY 100,000 $\approx$ EUR 12,500) who are likely to be busier. Maintenance methods are more concerned if homeowners have a higher degree of education or income. Meanwhile, homeowners who are currently unemployed or have already retired do not pay much attention to it, nor do homeowners who are generally not concerned with environmental issues.

The explanatory power of behavioral factors is not as significant as socio-demographic characteristics. It might be partly due to the so-called "response style bias": Chinese respondents have a tendency to prefer middle response over extreme response on ratings scales [41], which weakens the differentiation of questionnaire answers.

However, some tendencies can still be concluded. It is not surprising that homeowners will be more likely to be willing to participate if they have more knowledge about the renovation or hold a more positive attitude towards the renovation. Moreover, those who are more satisfied with the current indoor comfort level are also more eager to participate in the discussion. They might worry that the current comfort level and lifestyle cannot be maintained after the renovation. Thus, they need to weigh the pros and cons more carefully to make sure that the outcome of the renovation is desirable.

Contrary to our expectations, homeowners who have undertaken government-led renovation indicated a lower level of enthusiasm to participate. One possible reason is that homeowners were dissatisfied with the negotiation they had gone through, affecting their willingness to be involved in the same process again if the situation would not be significantly improved. It is also possible that during the past renovation process, they did not perceive their presence as important to the execution of the project.

5. Discussion

This study reveals the current nature of homeowners' participation in energy efficient renovation in China's Northern Heating Region. Corroborating findings of numerous previous studies [4,34,38,39,42,43], homeowners' participation is undoubtedly a critical issue to decrease energy consumption in the residential sector and realize large-scale deep renovation in the future.

Some difficulties in organizing homeowners' participation in apartment buildings are also identical in other countries or regions. One reason is that property rights' complex nature increases decision-making difficulties because diverse groups of occupants may have different interests [44]. This is prevalent in different cultural and religious backgrounds. For example, in the energy efficient renovation of Lithuanian apartment buildings, it was not easy to launch the renovation process because all flats were privatized, and the renovation needed the general approval of all the building co-owners [25]. Paiho [27] mentioned that apartment buildings in Russia typically have several hundreds of units, and the homeowners are rarely familiar with each other, making it hard to achieve a collective decision. Income levels may vary among the residents of the same building, which complicates joint decision-making on building renovation [27].

Some successful attempts to involve homeowners have achieved satisfactory outcomes in other countries or regions. However, due to the uniqueness of apartment buildings, experiences generated from another cultural and institutional context may not be applied to China. Therefore, based on the understanding of Chinese homeowners' experience and expectations, we endeavor to give some recommendations that are particularly suitable to Northern China's context and may also be generalized to countries or regions with similar situations.

5.1. Improve Relevant Laws and Regulations

In countries and regions where apartment units are privately owned, and no self-management forms of homeowners are established, the framework of building management is hard to build. In this study, some interviewees also mentioned that conflicts are prone to occur between homeowners and the working group because of the lack of a standardized regulation that can convince both parties. Many homeowners in old residential communities are skeptical of neighborhood committee members and property management company employees [7]. Thus, if people from these organizations force them to accept a renovation plan that will harm their interests without providing a reliable policy basis, they will be particularly rebellious. Policy support is necessary to clarify the process and avoid chaotic situations.

In many countries, homeowners' authority to participate is guaranteed at levels ranging from forming the constitution to planning regulations. There are specified procedures and steps to be followed during public participation in renovation projects. Meanwhile, in China, although the governments at the national and local level have published some programs to support housing energy efficient renovation, the audience of such programs are mainly developers and local governments. Most homeowners have never read the government's documents about renovation, nor do they know relevant policies. Thus, homeowners' intention to participate lacks sufficient encouragement; they are also unaware of their responsibilities and rights. Enhancing the presence of laws and regulations is imperative.

Adding several confirmation steps in the participation process can make it more rigorous. Every step should be justified and should follow clear regulations. Additionally, programs related to homeowners should not only focus on the pre-renovation phase and construction phase. The effect of renovation can only be ensured if the building is well-functioned and homeowners can adapt to it. A transparent responsibility system is needed to take care of the post-evaluation and supervision.

5.2. Establish Homeowner Associations

Homeowners' participation process in renovation projects is essentially a communication process supposed to provide homeowners with sufficient information. Some interviewees suggested that homeowners should have more chances to talk to people who are professional or in charge to gain knowledge and give feedback. However, the only approach for homeowners to communicate with other stakeholders is through a door-to-door visit, which will cost a large amount of effort and time for both working group members and homeowners, giving it relatively low efficiency. Lacking communication gives rise to misunderstandings between homeowners and the working group members and affect the process in return. It will even deteriorate homeowners' trust of the working group. When homeowners feel their interests are violated or believe they are treated unfairly, they have no trustworthy approaches to appeal. Although there is a high acceptance of energy efficient renovation at the individual level, this positive attitude may not translate into a collective decision.

A "bridge" needs to be built to connect the working group and the homeowners, through which homeowners' expectations can be better heard and treated. A possible solution is to authorize the homeowner association as a representative of homeowners, mitigating the communication cost between the opposing parties. In countries where homeowner associations have a stronger role, directors elected by the homeowners perform voluntary management work in an intensive and organized way; they are empowered to respond to important issues. In China, on the other hand, homeowner associations usually have no legal rights; however, they are generated as a grassroots power to deal with external grievances [45]. It can counterbalance different stakeholders and address homeowners' needs [46]. A homeowner association's quality of participatory representation is positively related to homeowners' level of participation; it can also help cultivate homeowners' willingness to participate in turn [47].

In addition, homeowner associations can enhance the relationship among neighbors in their daily life, and the residents in a friendly neighborhood will be more enthusiastic about participating in the management of the residential community, including the renovation decision. In apartment buildings, an individual homeowner is often unaware of the functional deficiencies of the whole building, nor do they know the problems that other homeowners are experiencing [21]. Homeowner associations can organize regular meetings or activities, which create opportunities for homeowners to communicate with each other. It can eliminate interpersonal estrangement and let people understand the situation of others better.

5.3. Develop Targeted Renovation and Participation Strategies

One of the difficulties in promoting energy efficient renovation is that every project is different. Researchers and practitioners have recognized the importance of designing renovation strategies based on the projects' physical conditions; however, little attention has been paid to the homeowners' characteristics.

In this study, we have interviewed homeowners from renovated residential communities. Despite considerable differences in their physical features and renovation measures, the homeowners' participation in these residential communities is similarly organized. However, even in the same residential community, different buildings' renovation processes and outcomes can differ significantly because the homeowners are different in many aspects. There is no one-time-for-all strategy.

Lacking homeowners' participation is only the surface phenomenon. The underlying mechanisms need to be understood and explored. There are several reasons why homeowners cannot fully participate and why their expectations deviate from reality. Some homeowners are reluctant to participate because they believe the renovation outcome is not desirable [33] and some do not realize that as the main stakeholder, they have the right and ability to participate in making major decisions [7], while in other cases, homeowners do not participate simply because they are not informed and have no idea of the upcoming

renovation [39]. It requires the working group members to be patient and nuanced during the door-to-door visits because homeowners often cannot express their perceived barriers to participating directly.

The census step before the renovation is also crucial. Our results suggest that different homeowner groups may have completely different preferences. Based on homeowners' characteristics in a particular building, the working group members can estimate their concerns and requirements in advance and be prepared to solve any problems.

For example, in many old residential communities, most homeowners are low-income elderly people. They are concerned less with the time plan, construction period, and maintenance methods because they stay at home mostly and have enough flexibility to respond to any conditions; meanwhile, regarding the working group members, they have a higher tendency to prefer government employees and neighborhood committee members instead of "professional people" who may deliver information in a way that they cannot understand. On the other hand, homeowners with a higher education level are more sensitive to technical details such as renovation measures and material selection. It might be more challenging to win their trust and approval. Nevertheless, once they agree on the renovation plan, they may become the "opinion leader" and motivate others.

6. Conclusions

Energy efficient renovation progress in China is directly associated with homeowners' participation. In this study, we explored the current nature of homeowners' participation and found it inadequate. The participation process was divided into three elements: steps and procedures, the composition of the working group, and the content to be discussed. By investigating homeowners' experiences in renovation projects, it is possible to draw the following conclusions: firstly, the ideal procedure was often not executed in renovation projects; secondly, there is a deviation between homeowners' expectations and the reality; thirdly, the participation process should be improved. Based on the interview and questionnaire survey results, some suggestions were proposed to enhance homeowners' participation in residential energy efficient renovation in China's Northern Heating Region.

The findings of this study may also contribute to a more comprehensive understanding of homeowners' role in energy efficient renovation. Whether the renovation strategies can achieve their purpose is heavily dependent on homeowners' reactions. Further research should explore the causes of the current situation and find innovative solutions. The long-neglected aspect is possibly the critical link in the wider diffusion of energy efficient renovation.

Author Contributions: Writing—original draft preparation, review, and editing, J.M.; supervision, Q.K.Q., H.V. and K.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Appendix A.1. Homeowners' Expectations and Experiences in Energy Efficient Renovation Survey

Thank you for participating in the survey. This questionnaire is part of a Ph.D. project to gather information about homeowners' participation and decision towards housing energy efficient renovation in the Northern Heating Region.

Please ensure that you are a homeowner that have been living in the Northern Heating Region for at least 3 consecutive years. If you are not the appropriate person to complete this questionnaire, please forward it to the correct person.

Some parts of the questionnaire are based on a brief introduction that help you to understand the questions. Please choose only one option out of all if there is a ○ before each option, and choose all the options that apply to you if there is a □ before each option.

It takes about 20 min to finish all the questions. Your answers will only be used for academic purposes. Your cooperation in completing the questionnaire will ensure the success of the project.

Appendix A.2. Part I: General Perspectives

Energy efficient renovation refers to the construction work to improve the energy performance and indoor comfort level of a building or a home. For example, replacing the old windows or doors with energy efficient products, upgrading the heating system, or attaching insulation material to the walls and roofs. Currently, the average cost of energy efficient renovation project is 200 yuan/m^2.

1. Have you heard of 'energy efficient renovation' before?
   - ○ Yes, and I clearly understand the meaning.
   - ○ Yes, but I didn't know the meaning.
   - ○ No, I've never heard of it.
2. What is your general attitude towards energy efficient renovation?
   - ○ Very positive: it should be promoted and encouraged.
   - ○ Positive: it sounds good, but I need more information to make a judgment.
   - ○ Neutral: I have no opinion towards it.
   - ○ Negative: I disagree about it.
3. Have you undertaken energy efficient renovation in the past ten years?
   - ○ Yes, I have done energy efficient renovation at my own expense.
   - ○ Yes, I have undertaken government-led energy efficient renovation project(s), in which I paid ____ yuan.
   - ○ Yes, I have undertaken government-led energy efficient renovation project(s), and I was not asked to pay.
   - ○ No.
   - ○ I don't know.

Appendix A.3. Part II: Expectations in Energy Efficient Renovation Project

Now, suppose a government-led energy efficient renovation project will be going on in the residential community you live in. Someone will come to your neighborhood, discuss the renovation's content, and ask for your agreement. Then, you will have some time to make a decision—undertake or not. If 70% of homeowners in the neighborhood decided to agree on the project, it would be put into operation. Please answer the following questions based on your expectations.

4. Would you agree to undertake the government-led energy efficient renovation project?
   - ○ I would undertake it and I would like to pay for it.
   - ○ I would undertake it only if I do not need to pay for it.
   - ○ No, I would rather renovate on my own initiative.
   - ○ No, I would not undertake any type of energy efficient renovation.

5. In which part(s) would you expect to be involved in the discussion of the project?
   - ☐ Renovation measures
   - ☐ Financial plan
   - ☐ Contractor
   - ☐ Construction team
   - ☐ Time plan
   - ☐ Construction plan
   - ☐ Material
   - ☐ Maintenance methods
   - ☐ I only want to be asked whether I agree with the pre-set plan
   - ☐ I do not want to be involved in the discussion at all
6. In the project, whom would you expect to be responsible to contact you?
   - ☐ Government employees
   - ☐ Energy company employees
   - ☐ Property management company employees
   - ☐ Neighborhood community members
   - ☐ Others (please specify): _____

Appendix A.4. Part III: Personal Information

7. What is your gender?
   - ○ Female
   - ○ Male
8. What is your age? Please fill in the number: _____
9. Which of the following best describes your current occupation status?
   - ○ Student
   - ○ Working (full-time)
   - ○ Unemployed/retired
   - ○ Other (please specify)
10. What is the estimated annual income (yuan) of your household?
    - ○ Up to 10,000
    - ○ 10,001–50,000
    - ○ 50,001–100,000
    - ○ 100,001–200,000
    - ○ More than 200,001
    - ○ I don't know
11. What is the highest level of education you completed?
    - ○ Middle school and below
    - ○ High school or college
    - ○ University
    - ○ Postgraduate and above
12. Now, please tell us about your home.

There are _____ floors in your dwelling. You and your family live at the _____ floor. The total floor area of your unit is _____ m^2. The building was built in _____ (year). You and your family have been living here since _____ (year).

13. How do you feel about the indoor environment (thermal comfort) of your current household?
    - ○ Very satisfied
    - ○ Fair
    - ○ Dissatisfied

14. How would you describe your attitude towards environmental protection?
    - ○ Very concerned: I understand the environmental impacts of my lifestyle. I have taken actions to reduce the energy consumption: I save energy in my daily life and I purchase energy efficient appliances.
    - ○ Generally concerned: I would like to adopt environmentally friendly behavior when it doesn't require a lot of effort. I do not want to sacrifice my benefits for the environmental protection.
    - ○ Unconcerned: I have no interest in environmental protection.
15. Do you have any additional concerns about energy efficient renovation? Please comment here.

You have already finished all the mandatory questions. If you have undertaken an energy efficient renovation, please continue to answer the questions in Part IV.

Appendix A.5. Part IV: Energy Efficient Renovation Experience

16. In which part(s) have you been involved in the discussion of the project?
    - ☐ Renovation measures
    - ☐ Financial plan
    - ☐ Contractor
    - ☐ Construction team
    - ☐ Time plan
    - ☐ Construction plan
    - ☐ Material
    - ☐ Maintenance methods
    - ☐ I was only asked if I agree with the pre-set plan
    - ☐ I was not involved in the discussion at all
17. Who was(were) responsible for contacting you during the whole process of the project?
    - ☐ Government
    - ☐ Energy company
    - ☐ Property management company
    - ☐ Neighborhood committee
    - ☐ Others (please specify) _____

This is the end of the survey. Are you interested in our research? Or would you like to take part in our further research? Please leave your contact information here.

TEL: _____ E-mail: _____ WeChat: _____ QQ: _____

Thank you for your attention!

Appendix B

Results of Chi-Square Tests of Independence

Table A1. Comparison of willingness to participate in the discussion on the decision of the renovation measures by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Willing to Participate in the Discussion on the Decision of Renovation Measures		Chi-Square Tests of Independence
		No n (%)	Yes n (%)	
Gender n (%)				
Male	227 (51.7)	55 (24.2)	172 (75.8)	χ^2 (1) = 0.407
Female	212 (48.2)	57 (26.9)	155 (73.1)	p = 0.523
Age in years n (%)				N = 439
30 and below	200 (46.1)	35 (17.5)	165 (82.5)	χ^2 (2) = 10.896
31–50	135 (31.1)	43 (31.9)	92 (68.1)	p = 0.004 **
≥51	99 (22.8)	30 (30.3)	69 (69.7)	N = 434
Occupation status n (%)				
Student	90 (21.5)	14 (15.6)	76 (84.4)	χ^2 (2) = 5.962
Full-time worker	249 (59.6)	67 (26.9)	182 (73.1)	p = 0.051
Unemployed/Retired	79 (18.9)	24 (30.4)	55 (69.6)	N = 418
Highest education level n (%)				
College and below	128 (29.7)	38 (29.7)	90 (70.3)	χ^2 (2) = 5.564
Undergraduate	183 (42.5)	50 (27.3)	133 (72.7)	p = 0.062
Postgraduate and above	120 (27.8)	21 (17.5)	99 (82.5)	N = 431
Annual household income n (%)				
CNY 100,000 and below	222 (51.4)	66 (29.7)	156 (70.3)	χ^2 (2) = 3.084
CNY 100,001–200,000	120 (27.8)	33 (27.5)	87 (72.5)	p = 0.214
≥CNY 200,000	90 (20.8)	18 (20.0)	72 (80.0)	N = 432
Total floor of building n (%)				
6 floors and below	225 (48.9)	63 (28.0)	162 (72.0)	χ^2 (1) = 0.836
≥7 floors	235 (51.1)	57 (24.3)	178 (75.7)	p = 0.361
Floor area of unit n (%)				N = 460
50 m^2 and below	93 (20.6)	25 (26.9)	68 (73.1)	
51 m^2 to 90 m^2	161 (35.6)	51 (31.7)	110 (68.3)	χ^2 (3) = 5.554
91 m^2 to 120 m^2	109 (24.1)	21 (19.3)	88 (80.7)	p = 0.135
≥121 m^2	89 (19.7)	21 (23.6)	68 (76.4)	N = 452
Satisfaction of indoor comfort				
Dissatisfied	110 (23.7)	37 (33.6)	73 (66.4)	χ^2 (2) = 3.664
Fair	314 (67.7)	81 (25.8)	233 (74.2)	p = 0.160
Very satisfied	40 (8.6)	8 (20.0)	32 (80.0)	N = 464
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	47 (32.2)	99 (67.8)	χ^2 (2) = 7.812
General concerned	251 (54.9)	54 (21.5)	197 (78.5)	p = 0.020 *
Very concerned	60 (13.1)	21 (35.0)	39 (65.0)	N = 457
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	27 (36.5)	47 (63.5)	χ^2 (2) = 5.376
Heard about it	226 (48.0)	61 (27.0)	165 (73.0)	p = 0.068
Clearly understand the meaning	171 (36.3)	38 (22.2)	133 (77.8)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.8)	13 (40.6)	19 (59.4)	χ^2 (2) = 4.382
Positive	224 (47.6)	53 (23.7)	171 (76.3)	p = 0.112
Very positive	215 (45.6)	60 (27.9)	155 (72.1)	N = 471
Experience of renovation				
Non-renovated	376 (80.7)	97 (25.8)	279 (74.2)	χ^2 (1) = 1.519
Renovated	90 (19.3)	29 (32.2)	61 (67.8)	p = 0.218
				N = 466

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A2. Comparison of willingness to participate in the discussion on the decision of the financial plan by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Willing to Participate in the Discussion on the Decision of Financial Plan		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	227 (51.7)	90 (39.6)	137 (60.4)	χ^2 (1) = 0.088
Female	212 (48.2)	87 (41.0)	125 (59.0)	p = 0.767
Age in years n (%)				N = 439
30 and below	200 (46.1)	71 (35.5)	129 (64.5)	χ^2 (2) = 5.435
31–50	135 (31.1)	65 (48.1)	70 (51.9)	p = 0.066
≥51	99 (22.8)	42 (42.4)	57 (57.6)	N = 434
Occupation status n (%)				
Student	90 (21.5)	31 (34.4)	59 (65.6)	χ^2 (2) = 2.730
Full-time worker	249 (59.6)	98 (39.4)	151 (60.6)	p = 0.255
Unemployed/Retired	79 (18.9)	37 (46.8)	42 (53.2)	N = 418
Highest education level n (%)				
College and below	128 (29.7)	58 (45.3)	70 (54.7)	χ^2 (2) = 7.510
Undergraduate	183 (42.5)	80 (43.7)	103 (56.3)	p = 0.023 *
Postgraduate and above	120 (27.8)	36 (30.0)	84 (70.0)	N = 431
Annual household income n (%)				
CNY 100,000 and below	222 (51.4)	98 (44.1)	124 (55.9)	χ^2 (2) = 3.855
CNY 100,001–200,000	120 (27.8)	40 (33.3)	80 (66.7)	p = 0.145
≥CNY 200,000	90 (20.8)	35 (38.9)	55 (61.1)	N = 432
Total floor of building n (%)				
6 floors and below	225 (48.9)	84 (37.3)	141 (62.7)	χ^2 (1) = 2.011
≥7 floors	235 (51.1)	103 (43.8)	132 (56.2)	p = 0.156
Floor area of unit n (%)				N = 460
50 m^2 and below	93 (20.6)	37 (39.8)	56 (60.2)	
51 m^2 to 90 m^2	161 (35.6)	72 (44.7)	89 (55.3)	χ^2 (3) = 1.518
91 m^2 to 120 m^2	109 (24.1)	45 (41.3)	64 (58.7)	p = 0.678
≥121 m^2	89 (19.7)	33 (37.1)	56 (62.9)	N = 452
Satisfaction of indoor comfort				
Dissatisfied	110 (23.7)	46 (41.8)	64 (58.2)	χ^2 (2) = 0.590
Fair	314 (67.7)	128 (40.8)	186 (59.2)	p = 0.744
Very satisfied	40 (8.6)	14 (35.0)	26 (65.0)	N = 464
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	64 (43.8)	82 (56.2)	χ^2 (2) = 2.147
General concerned	251 (54.9)	94 (37.5)	157 (62.5)	p = 0.342
Very concerned	60 (13.1)	27 (45.0)	33 (55.0)	N = 457
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	39 (52.7)	35 (47.3)	χ^2 (2) = 5.222
Heard about it	226 (48.0)	90 (39.8)	136 (60.2)	p = 0.073
Clearly understand the meaning	171 (36.3)	64 (37.4)	107 (62.6)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.8)	21 (65.6)	11 (34.4)	χ^2 (2) = 8.741
Positive	224 (47.6)	86 (38.4)	138 (61.6)	p = 0.013 *
Very positive	215 (45.6)	86 (40.0)	129 (60.0)	N = 471
Experience of renovation				
Non-renovated	376 (80.7)	149 (39.6)	227 (60.4)	χ^2 (1) = 1.488
Renovated	90 (19.3)	42 (46.7)	48 (53.3)	p = 0.223
				N = 466

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A3. Comparison of willingness to participate in the discussion on the decision of the contractor by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Willing to Participate in the Discussion on the Decision of Contractor		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	227 (51.7)	174 (76.7)	53 (23.3)	χ^2 (1) = 0.933
Female	212 (48.2)	154 (72.6)	58 (27.4)	p = 0.334
Age in years n (%)				N = 439
30 and below	200 (46.1)	135 (67.5)	65 (32.5)	χ^2 (2) = 10.445
31–50	135 (31.1)	105 (77.8)	30 (22.2)	p = 0.005 **
≥51	99 (22.8)	83 (83.8)	16 (16.2)	N = 434
Occupation status n (%)				
Student	90 (21.5)	61 (67.8)	29 (32.2)	χ^2 (2) = 4.648
Full-time worker	249 (59.6)	185 (74.3)	64 (25.7)	p = 0.098
Unemployed/Retired	79 (18.9)	65 (82.3)	14 (17.7)	N = 418
Highest education level n (%)				
College and below	128 (29.7)	109 (85.2)	19 (14.8)	χ^2 (2) = 12.547
Undergraduate	183 (42.5)	135 (73.8)	48 (26.2)	p = 0.002 **
Postgraduate and above	120 (27.8)	79 (65.8)	41 (34.2)	N = 431
Annual household income n (%)				
CNY 100,000 and below	222 (51.4)	172 (77.5)	50 (22.5)	χ^2 (2) = 6.128
CNY 100,001–200,000	120 (27.8)	92 (76.7)	28 (23.3)	p = 0.047 *
≥CNY 200,000	90 (20.8)	58 (64.4)	32 (35.6)	N = 432
Total floor of building n (%)				
6 floors and below	225 (48.9)	174 (77.3)	51 (22.7)	χ^2 (1) = 2.058
≥7 floors	235 (51.1)	168 (71.5)	67 (28.5)	p = 0.151
Floor area of unit n (%)				N = 460
50 m^2 and below	93 (20.6)	70 (75.3)	23 (24.7)	
51 m^2 to 90 m^2	161 (35.6)	124 (77.0)	37 (23.0)	χ^2 (3) = 3.891
91 m^2 to 120 m^2	109 (24.1)	74 (67.9)	35 (32.1)	p = 0.274
≥121 m^2	89 (19.7)	70 (78.7)	19 (21.3)	N = 452
Satisfaction of indoor comfort				
Dissatisfied	110 (23.7)	81 (73.6)	29 (26.4)	χ^2 (2) = 2.560
Fair	314 (67.7)	240 (76.4)	74 (23.6)	p = 0.278
Very satisfied	40 (8.6)	26 (65.0)	14 (35.0)	N = 464
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	116 (79.5)	30 (20.5)	χ^2 (2) = 3.059
General concerned	251 (54.9)	180 (71.7)	71 (28.3)	p = 0.217
Very concerned	60 (13.1)	46 (76.7)	14 (23.3)	N = 457
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	55 (74.3)	19 (25.7)	χ^2 (2) = 1.057
Heard about it	226 (48.0)	174 (77.0)	52 (23.0)	p = 0.589
Clearly understand the meaning	171 (36.3)	124 (72.5)	47 (27.5)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.8)	25 (78.1)	7 (21.9)	χ^2 (2) = 1.581
Positive	224 (47.6)	162 (72.3)	62 (27.7)	p = 0.454
Very positive	215 (45.6)	166 (77.2)	49 (22.8)	N = 471
Experience of renovation				
Non-renovated	376 (80.7)	275 (73.1)	101 (26.9)	χ^2 (1) = 3.187
Renovated	90 (19.3)	74 (82.2)	16 (17.8)	p = 0.074
				N = 466

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A4. Comparison of willingness to participate in the discussion on the decision of the construction team by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Willing to Participate in the Discussion on the Decision of Construction Team		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	227 (51.7)	172 (75.8)	55 (24.2)	χ^2 (1) = 1.411
Female	212 (48.2)	150 (70.8)	62 (29.2)	p = 0.235
Age in years n (%)				N = 439
30 and below	200 (46.1)	139 (69.5)	61 (30.5)	χ^2 (2) = 2.701
31–50	135 (31.1)	103 (78.3)	32 (23.7)	p = 0.259
≥51	99 (22.8)	76 (76.8)	23 (23.3)	N = 434
Occupation status n (%)				
Student	90 (21.5)	62 (68.9)	28 (31.1)	χ^2 (2) = 1.484
Full-time worker	249 (59.6)	182 (73.1)	67 (26.9)	p = 0.476
Unemployed/Retired	79 (18.9)	61 (77.2)	18 (27.8)	N = 418
Highest education level n (%)				
College and below	128 (29.7)	100 (78.1)	28 (21.9)	χ^2 (2) = 6.431
Undergraduate	183 (42.5)	139 (76.0)	44 (24.0)	p = 0.040 *
Postgraduate and above	120 (27.8)	78 (65.0)	42 (35.0)	N = 431
Annual household income n (%)				
CNY 100,000 and below	222 (51.4)	174 (78.4)	48 (21.6)	χ^2 (2) = 4.375
CNY 100,001–200,000	120 (27.8)	86 (71.7)	34 (28.3)	p = 0.112
≥CNY 200,000	90 (20.8)	61 (67.8)	29 (32.2)	N = 432
Total floor of building n (%)				
6 floors and below	225 (48.9)	167 (74.2)	58 (25.8)	χ^2 (1) = 0.063
≥7 floors	235 (51.1)	172 (73.2)	62 (26.8)	p = 0.802
Floor area of unit n (%)				N = 460
50 m^2 and below	93 (20.6)	75 (80.6)	18 (19.4)	
51 m^2 to 90 m^2	161 (35.6)	127 (78.9)	34 (21.1)	χ^2 (3) = 8.955
91 m^2 to 120 m^2	109 (24.1)	73 (67.0)	36 (33.0)	p = 0.030 *
≥121 m^2	89 (19.7)	60 (67.4)	29 (32.6)	N = 452
Satisfaction of indoor comfort				
Dissatisfied	110 (23.7)	82 (74.5)	28 (25.5)	χ^2 (2) = 1.811
Fair	314 (67.7)	235 (74.8)	79 (25.2)	p = 0.404
Very satisfied	40 (8.6)	26 (65.0)	14 (35.0)	N = 464
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	107 (73.7)	39 (26.7)	χ^2 (2) = 0.686
General concerned	251 (54.9)	184 (73.3)	67 (26.7)	p = 0.710
Very concerned	60 (13.1)	47 (78.3)	13 (21.7)	N = 457
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	56 (75.7)	18 (24.3)	χ^2 (2) = 3.222
Heard about it	226 (48.0)	175 (77.4)	51 (22.6)	p = 0.200
Clearly understand the meaning	171 (36.3)	119 (69.6)	52 (30.4)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.8)	25 (78.1)	7 (21.9)	χ^2 (2) = 0.422
Positive	224 (47.6)	164 (73.2)	60 (26.8)	p = 0.810
Very positive	215 (45.6)	161 (74.9)	54 (25.1)	N = 471
Experience of renovation				
Non-renovated	376 (80.7)	272 (72.3)	104 (27.7)	χ^2 (1) = 3.709
Renovated	90 (19.3)	74 (82.2)	16 (17.8)	p = 0.054
				N = 466

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A5. Comparison of willingness to participate in the discussion on the decision of the time plan by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Willing to Participate in the Discussion on the Decision of Time Plan		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	227 (51.7)	107 (47.1)	120 (52.9)	χ^2 (1) = 3.569
Female	212 (48.2)	81 (38.2)	131 (61.8)	p = 0.059
Age in years n (%)				N = 439
30 and below	200 (46.1)	70 (35.0)	130 (65.0)	χ^2 (2) = 11.128
31–50	135 (31.1)	65 (48.1)	70 (51.9)	p = 0.004 **
≥51	99 (22.8)	53 (53.5)	46 (46.5)	N = 434
Occupation status n (%)				
Student	90 (21.5)	32 (35.6)	58 (64.4)	χ^2 (2) = 7.641
Full-time worker	249 (59.6)	102 (41.0)	147 (59.0)	p = 0.022 *
Unemployed/Retired	79 (18.9)	44 (55.7)	35 (44.3)	N = 418
Highest education level n (%)				
College and below	128 (29.7)	64 (50.0)	64 (50.0)	χ^2 (2) = 15.873
Undergraduate	183 (42.5)	87 (47.5)	96 (52.5)	p = 0.000 ***
Postgraduate and above	120 (27.8)	33 (27.5)	87 (72.5)	N = 431
Annual household income n (%)				
CNY 100,000 and below	222 (51.4)	114 (51.4)	108 (48.6)	χ^2 (2) = 10.263
CNY 100,001–200,000	120 (27.8)	45 (37.5)	75 (62.5)	p = 0.006 **
≥CNY 200,000	90 (20.8)	31 (34.4)	69 (65.6)	N = 432
Total floor of building n (%)				
6 floors and below	225 (48.9)	97 (43.1)	128 (56.9)	χ^2 (1) = 0.273
≥7 floors	235 (51.1)	107 (45.5)	128 (54.5)	p = 0.601
Floor area of unit n (%)				N = 460
50 m^2 and below	93 (20.6)	39 (41.9)	54 (58.1)	
51 m^2 to 90 m^2	161 (35.6)	75 (46.6)	86 (53.4)	χ^2 (3) = 0.847
91 m^2 to 120 m^2	109 (24.1)	51 (46.8)	58 (53.2)	p = 0.838
≥121 m^2	89 (19.7)	38 (42.7)	51 (57.3)	N = 452
Satisfaction of indoor comfort				
Dissatisfied	110 (23.7)	53 (48.2)	57 (51.8)	χ^2 (2) = 1.677
Fair	314 (67.7)	133 (42.4)	181 (57.6)	p = 0.432
Very satisfied	40 (8.6)	20 (50.0)	20 (50.0)	N = 464
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	67 (45.9)	79 (54.1)	χ^2 (2) = 4.923
General concerned	251 (54.9)	103 (41.0)	148 (59.0)	p = 0.085
Very concerned	60 (13.1)	34 (56.7)	26 (43.3)	N = 457
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	35 (47.3)	39 (52.7)	χ^2 (2) = 0.736
Heard about it	226 (48.0)	103 (45.6)	123 (54.4)	p = 0.692
Clearly understand the meaning	171 (36.3)	72 (42.1)	99 (57.9)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.8)	19 (59.4)	13 (40.6)	χ^2 (2) = 5.290
Positive	224 (47.6)	90 (40.2)	134 (59.8)	p = 0.071
Very positive	215 (45.6)	101 (47.4)	113 (52.6)	N = 471
Experience of renovation				
Non-renovated	376 (80.7)	159 (42.3)	217 (57.7)	χ^2 (1) = 3.589
Renovated	90 (19.3)	48 (53.3)	42 (46.7)	p = 0.058
				N = 466

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A6. Comparison of willingness to participate in the discussion on the decision of the construction plan by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Willing to Participate in the Discussion on the Decision of Construction Plan		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	227 (51.7)	137 (60.4)	90 (39.6)	χ^2 (1) = 2.527
Female	212 (48.2)	112 (52.8)	100 (47.2)	p = 0.112
Age in years n (%)				N = 439
30 and below	200 (46.1)	100 (50.0)	100 (50.0)	χ^2 (2) = 6.475
31–50	135 (31.1)	82 (60.7)	53 (39.3)	p = 0.039 *
≥51	99 (22.8)	63 (63.6)	36 (36.4)	N = 434
Occupation status n (%)				
Student	90 (21.5)	45 (50.0)	45 (50.0)	χ^2 (2) = 3.696
Full-time worker	249 (59.6)	138 (55.4)	111 (44.6)	p = 0.158
Unemployed/Retired	79 (18.9)	51 (64.6)	28 (35.4)	N = 418
Highest education level n (%)				
College and below	128 (29.7)	73 (57.0)	55 (43.0)	χ^2 (2) = 5.584
Undergraduate	183 (42.5)	112 (61.2)	71 (38.8)	p = 0.061
Postgraduate and above	120 (27.8)	57 (47.5)	63 (52.5)	N = 431
Annual household income n (%)				
CNY 100,000 and below	222 (51.4)	143 (64.4)	79 (35.6)	χ^2 (2) = 8.613
CNY 100,001–200,000	120 (27.8)	60 (50.0)	60 (50.0)	p = 0.013 *
≥CNY 200,000	90 (20.8)	46 (51.1)	44 (48.9)	N = 432
Total floor of building n (%)				
6 floors and below	225 (48.9)	131 (58.2)	94 (41.8)	χ^2 (1) = 0.124
≥7 floors	235 (51.1)	133 (56.6)	102 (43.4)	p = 0.724
Floor area of unit n (%)				N = 460
50 m^2 and below	93 (20.6)	54 (58.1)	39 (41.9)	
51 m^2 to 90 m^2	161 (35.6)	96 (59.6)	65 (40.4)	χ^2 (3) = 0.535
91 m^2 to 120 m^2	109 (24.1)	62 (56.9)	47 (43.1)	p = 0.911
≥121 m^2	89 (19.7)	49 (55.1)	40 (44.9)	N = 452
Satisfaction of indoor comfort				
Dissatisfied	110 (23.7)	72 (65.5)	38 (34.5)	χ^2 (2) = 4.756
Fair	314 (67.7)	176 (56.1)	138 (43.9)	p = 0.093
Very satisfied	40 (8.6)	19 (47.5)	21 (52.5)	N = 464
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	92 (63.0)	54 (37.0)	χ^2 (2) = 2.964
General concerned	251 (54.9)	136 (54.2)	115 (45.8)	p = 0.227
Very concerned	60 (13.1)	35 (58.3)	25 (41.7)	N = 457
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	46 (62.2)	28 (37.8)	χ^2 (2) = 1.237
Heard about it	226 (48.0)	133 (58.8)	93 (41.2)	p = 0.539
Clearly understand the meaning	171 (36.3)	94 (55.0)	77 (45.0)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.8)	21 (65.6)	11 (34.4)	χ^2 (2) = 9.912
Positive	224 (47.6)	113 (50.4)	111 (49.6)	p = 0.007 **
Very positive	215 (45.6)	139 (64.7)	76 (35.3)	N = 471
Experience of renovation				
Non-renovated	376 (80.7)	213 (56.6)	163 (43.4)	χ^2 (1) = 1.813
Renovated	90 (19.3)	58 (64.4)	32 (35.6)	p = 0.178
				N = 466

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A7. Comparison of willingness to participate in the discussion on the decision of the material by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Willing to Participate in the Discussion on the Decision of Material		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	227 (51.7)	97 (42.7)	130 (57.3)	χ^2 (1) = 0.698
Female	212 (48.2)	99 (46.7)	113 (53.3)	p = 0.403
Age in years n (%)				N = 439
30 and below	200 (46.1)	76 (38.0)	124 (62.0)	χ^2 (2) = 5.855
31–50	135 (31.1)	67 (49.6)	68 (50.4)	p = 0.054
≥51	99 (22.8)	49 (49.5)	50 (50.5)	N = 434
Occupation status n (%)				
Student	90 (21.5)	36 (40.0)	54 (60.0)	χ^2 (2) = 1.127
Full-time worker	249 (59.6)	110 (44.2)	139 (55.8)	p = 0.569
Unemployed/Retired	79 (18.9)	38 (48.1)	41 (51.9)	N = 418
Highest education level n (%)				
College and below	128 (29.7)	61 (47.7)	67 (52.3)	χ^2 (2) = 16.630
Undergraduate	183 (42.5)	96 (52.5)	87 (47.5)	p = 0.000 ***
Postgraduate and above	120 (27.8)	35 (29.2)	85 (70.8)	N = 431
Annual household income n (%)				
CNY 100,000 and below	222 (51.4)	109 (49.1)	113 (50.9)	χ^2 (2) = 2.972
CNY 100,001–200,000	120 (27.8)	52 (43.3)	68 (56.7)	p = 0.226
≥CNY 200,000	90 (20.8)	35 (38.9)	55 (61.1)	N = 432
Total floor of building n (%)				
6 floors and below	225 (48.9)	106 (47.1)	119 (52.9)	χ^2 (1) = 0.273
≥7 floors	235 (51.1)	105 (44.7)	130 (55.3)	p = 0.601
Floor area of unit n (%)				N = 460
50 m^2 and below	93 (20.6)	42 (45.2)	51 (54.8)	
51 m^2 to 90 m^2	161 (35.6)	75 (46.6)	86 (53.4)	χ^2 (3) = 0.836
91 m^2 to 120 m^2	109 (24.1)	47 (43.1)	62 (56.9)	p = 0.841
≥121 m^2	89 (19.7)	44 (49.4)	45 (50.6)	N = 452
Satisfaction of indoor comfort				
Dissatisfied	110 (23.7)	57 (51.8)	53 (48.2)	χ^2 (2) = 2.551
Fair	314 (67.7)	145 (46.2)	169 (53.8)	p = 0.279
Very satisfied	40 (8.6)	15 (37.5)	25 (62.5)	N = 464
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	74 (50.7)	72 (49.3)	χ^2 (2) = 4.968
General concerned	251 (54.9)	105 (41.8)	146 (58.2)	p = 0.083
Very concerned	60 (13.1)	33 (55.0)	27 (45.0)	N = 457
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	45 (60.8)	29 (39.2)	χ^2 (2) = 7.589
Heard about it	226 (48.0)	102 (45.1)	124 (54.9)	p = 0.022 *
Clearly understand the meaning	171 (36.3)	72 (42.1)	99 (57.9)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.8)	19 (59.4)	13 (40.6)	χ^2 (2) = 2.860
Positive	224 (47.6)	106 (47.3)	118 (52.7)	p = 0.239
Very positive	215 (45.6)	94 (43.7)	121 (56.3)	N = 471
Experience of renovation				
Non-renovated	376 (80.7)	166 (44.1)	210 (55.9)	χ^2 (1) = 3.097
Renovated	90 (19.3)	49 (54.4)	41 (45.6)	p = 0.078
				N = 466

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A8. Comparison of willingness to participate in the discussion on the decision of the maintenance methods by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Willing to Participate in the Discussion on the Decision of Maintenance Methods		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	227 (51.7)	101 (44.5)	126 (55.5)	χ^2 (1) = 0.398
Female	212 (48.2)	88 (41.5)	124 (58.5)	p = 0.528
Age in years n (%)				N = 439
30 and below	200 (46.1)	78 (39.0)	122 (61.0)	χ^2 (2) = 3.597
31–50	135 (31.1)	57 (42.2)	78 (57.8)	p = 0.166
≥51	99 (22.8)	50 (50.5)	49 (49.5)	N = 434
Occupation status n (%)				
Student	90 (21.5)	32 (35.6)	58 (54.4)	χ^2 (2) = 6.620
Full-time worker	249 (59.6)	102 (41.0)	147 (59.0)	p = 0.037 *
Unemployed/Retired	79 (18.9)	43 (54.4)	36 (45.6)	N = 418
Highest education level n (%)				
College and below	128 (29.7)	62 (48.4)	66 (51.6)	χ^2 (2) = 11.013
Undergraduate	183 (42.5)	86 (47.0)	97 (53.0)	p = 0.004 **
Postgraduate and above	120 (27.8)	36 (30.0)	84 (70.0)	N = 431
Annual household income n (%)				
CNY 100,000 and below	222 (51.4)	112 (50.5)	110 (49.5)	χ^2 (2) = 6.741
CNY 100,001–200,000	120 (27.8)	49 (40.8)	71 (59.2)	p = 0.034 *
≥CNY 200,000	90 (20.8)	32 (35.6)	58 (64.4)	N = 432
Total floor of building n (%)				
6 floors and below	225 (48.9)	98 (43.6)	127 (56.4)	χ^2 (1) = 0.112
≥7 floors	235 (51.1)	106 (45.1)	129 (54.9)	p = 0.738
Floor area of unit n (%)				N = 460
50 m^2 and below	93 (20.6)	46 (49.5)	47 (50.5)	
51 m^2 to 90 m^2	161 (35.6)	74 (46.0)	87 (54.0)	χ^2 (3) = 1.575
91 m^2 to 120 m^2	109 (24.1)	46 (42.2)	63 (57.8)	p = 0.665
≥121 m^2	89 (19.7)	37 (41.6)	52 (58.4)	N = 452
Satisfaction of indoor comfort				
Dissatisfied	110 (23.7)	53 (48.2)	57 (51.8)	χ^2 (2) = 2.088
Fair	314 (67.7)	138 (43.9)	176 (56.1)	p = 0.352
Very satisfied	40 (8.6)	14 (35.0)	26 (65.0)	N = 464
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	72 (49.3)	74 (50.7)	χ^2 (2) = 2.126
General concerned	251 (54.9)	105 (41.8)	146 (58.2)	p = 0.345
Very concerned	60 (13.1)	26 (43.3)	34 (56.7)	N = 457
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	35 (47.3)	39 (52.7)	χ^2 (2) = 0.277
Heard about it	226 (48.0)	99 (43.8)	127 (56.2)	p = 0.871
Clearly understand the meaning	171 (36.3)	76 (44.4)	95 (55.6)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.8)	20 (62.5)	12 (37.5)	χ^2 (2) = 6.401
Positive	224 (47.6)	90 (40.2)	134 (59.8)	p = 0.041 *
Very positive	215 (45.6)	101 (47.0)	114 (53.0)	N = 471
Experience of renovation				
Non-renovated	376 (80.7)	166 (44.1)	210 (55.9)	χ^2 (1) = 0.058
Renovated	90 (19.3)	41 (45.6)	49 (54.4)	p = 0.809
				N = 466

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A9. Comparison of preference to include government employees in the working group by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Preference to Include Government Employees in the Working Group		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	229 (51.9)	56 (24.5)	173 (75.5)	χ^2 (1) = 8.505
Female	212 (48.1)	79 (37.3)	133 (62.7)	p = 0.004 **
Age in years n (%)				N = 441
30 and below	200 (45.9)	67 (33.5)	133 (66.5)	χ^2 (2) = 2.900
31–50	136 (31.2)	40 (29.4)	96 (70.6)	p = 0.235
≥51	100 (22.9)	24 (24.0)	76 (76.0)	N = 436
Occupation status n (%)				
Student	90 (21.5)	28 (31.1)	62 (68.9)	χ^2 (2) = 3.340
Full-time worker	249 (59.4)	83 (33.3)	166 (66.7)	p = 0.188
Unemployed/Retired	80 (19.1)	18 (22.5)	62 (77.5)	N = 419
Highest education level n (%)				
College and below	130 (30.0)	35 (26.9)	95 (73.1)	χ^2 (2) = 2.072
Undergraduate	183 (42.3)	63 (34.4)	120 (65.6)	p = 0.355
Postgraduate and above	120 (27.7)	36 (30.0)	84 (70.0)	N = 433
Annual household income n (%)				
CNY 100,000 and below	224 (51.6)	58 (25.9)	166 (74.1)	χ^2 (2) = 4.198
CNY 100,001−200,000	120 (27.6)	43 (35.8)	77 (64.2)	p = 0.123
≥CNY 200,000	90 (20.8)	30 (33.3)	60 (66.7)	N = 434
Total floor of building n (%)				
6 floors and below	225 (48.8)	67 (29.8)	158 (70.2)	χ^2 (1) = 0.073
≥7 floors	236 (51.2)	73 (30.9)	163 (69.1)	p = 0.788
Floor area of unit n (%)				N = 461
50 m^2 and below	92 (20.3)	27 (29.3)	65 (70.7)	
51 m^2 to 90 m^2	162 (35.8)	43 (26.5)	119 (73.5)	χ^2 (3) = 2.957
91 m^2 to 120 m^2	109 (24.1)	31 (28.4)	78 (71.6)	p = 0.398
≥121 m^2	90 (19.8)	33 (36.7)	57 (63.3)	N = 453
Satisfaction of indoor comfort				
Dissatisfied	110 (23.8)	29 (26.4)	81 (73.6)	χ^2 (2) = 1.949
Fair	313 (67.6)	105 (33.5)	208 (66.5)	p = 0.377
Very satisfied	40 (8.6)	13 (32.5)	27 (67.5)	N = 463
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	53 (36.3)	93 (63.7)	χ^2 (2) = 1.933
General concerned	250 (54.8)	74 (29.6)	176 (70.4)	p = 0.380
Very concerned	60 (13.2)	20 (33.3)	40 (66.7)	N = 456
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	21 (28.4)	53 (71.6)	χ^2 (2) = 3.191
Heard about it	225 (48.0)	79 (35.1)	146 (64.9)	p = 0.203
Clearly understand the meaning	173 (36.3)	47 (27.2)	126 (72.8)	N = 472
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.7)	12 (37.5)	20 (62.5)	χ^2 (2) = 1.967
Positive	223 (47.7)	74 (33.2)	149 (66.8)	p = 0.374
Very positive	217 (45.6)	61 (28.1)	156 (71.9)	N = 472
Experience of renovation				
Non-renovated	378 (80.8)	118 (31.2)	260 (68.8)	χ^2 (1) = 0.151
Renovated	90 (19.2)	30 (33.3)	60 (66.7)	p = 0.698
				N = 468

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A10. Comparison of preference to include energy company employees in the working group by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Preference to Include Energy Company Employees in the Working Group		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	229 (51.9)	121 (52.8)	108 (47.2)	χ^2 (1) = 0.797
Female	212 (48.1)	103 (48.6)	109 (51.4)	p = 0.372
Age in years n (%)				N = 441
30 and below	200 (45.9)	88 (44.0)	112 (56.0)	χ^2 (2) = 7.315
31–50	136 (31.2)	72 (52.9)	64 (47.1)	p = 0.026 *
≥51	100 (22.9)	60 (60.0)	40 (40.0)	N = 436
Occupation status n (%)				
Student	90 (21.5)	37 (41.1)	53 (58.9)	χ^2 (2) = 8.712
Full-time worker	249 (59.4)	127 (51.0)	122 (49.0)	p = 0.013 *
Unemployed/Retired	80 (19.1)	51 (63.7)	29 (36.3)	N = 419
Highest education level n (%)				
College and below	130 (30.0)	70 (53.8)	60 (46.2)	χ^2 (2) = 0.549
Undergraduate	183 (42.3)	94 (51.4)	89 (48.6)	p = 0.760
Postgraduate and above	120 (27.7)	59 (49.2)	61 (50.8)	N = 433
Annual household income n (%)				
CNY 100,000 and below	224 (51.6)	121 (54.0)	103 (46.0)	χ^2 (2) = 0.234
CNY 100,001–200,000	120 (27.6)	63 (52.5)	57 (47.5)	p = 0.890
≥CNY 200,000	90 (20.8)	46 (51.1)	44 (48.9)	N = 434
Total floor of building n (%)				
6 floors and below	225 (48.8)	114 (50.7)	111 (49.3)	χ^2 (1) = 0.162
≥7 floors	236 (51.2)	124 (52.5)	112 (47.5)	p = 0.687
Floor area of unit n (%)				N = 461
50 m^2 and below	92 (20.3)	49 (53.3)	43 (46.7)	
51 m^2 to 90 m^2	162 (35.8)	82 (50.6)	80 (49.4)	χ^2 (3) = 0.329
91 m^2 to 120 m^2	109 (24.1)	55 (50.5)	54 (49.5)	p = 0.955
≥121 m^2	90 (19.8)	48 (53.3)	42 (46.7)	N = 453
Satisfaction of indoor comfort				
Dissatisfied	110 (23.8)	66 (60.0)	44 (40.0)	χ^2 (2) = 6.219
Fair	313 (67.6)	161 (51.4)	152 (48.6)	p = 0.045 *
Very satisfied	40 (8.6)	15 (37.5)	25 (62.5)	N = 463
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	87 (59.6)	59 (40.4)	χ^2 (2) = 4.276
General concerned	250 (54.8)	123 (49.2)	127 (50.8)	p = 0.118
Very concerned	60 (13.2)	34 (56.7)	26 (43.3)	N = 456
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	44 (59.5)	30 (40.5)	χ^2 (2) = 2.314
Heard about it	225 (48.0)	111 (49.3)	114 (50.7)	p = 0.314
Clearly understand the meaning	173 (36.3)	91 (52.6)	82 (47.4)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.7)	18 (56.3)	14 (43.8)	χ^2 (2) = 4.294
Positive	223 (47.7)	105 (47.1)	118 (52.9)	p = 0.117
Very positive	217 (45.6)	123 (56.7)	94 (43.3)	N = 472
Experience of renovation				
Non-renovated	378 (80.8)	195 (51.6)	183 (48.4)	χ^2 (1) = 0.459
Renovated	90 (19.2)	50 (55.6)	40 (44.4)	p = 0.498
				N = 468

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A11. Comparison of preference to include property management company employees in the working group by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Preference to Include Property Management Company Employees in the Working Group		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	229 (51.9)	156 (68.1)	73 (31.9)	χ^2 (1) = 0.325
Female	212 (48.1)	139 (65.6)	73 (34.4)	p = 0.569
Age in years n (%)				N = 441
30 and below	200 (45.9)	123 (61.5)	77 (38.5)	χ^2 (2) = 10.525
31–50	136 (31.2)	89 (65.4)	47 (34.6)	p = 0.005 **
≥51	100 (22.9)	80 (80.0)	20 (20.0)	N = 436
Occupation status n (%)				
Student	90 (21.5)	54 (60.0)	36 (40.0)	χ^2 (2) = 9.927
Full-time worker	249 (59.4)	161 (64.7)	88 (35.3)	p = 0.007 **
Unemployed/Retired	80 (19.1)	65 (81.3)	15 (18.8)	N = 419
Highest education level n (%)				
College and below	130 (30.0)	102 (78.5)	28 (21.5)	χ^2 (2) = 12.336
Undergraduate	183 (42.3)	112 (61.2)	71 (38.8)	p = 0.002 **
Postgraduate and above	120 (27.7)	73 (60.8)	47 (39.2)	N = 433
Annual household income n (%)				
CNY 100,000 and below	224 (51.6)	154 (68.8)	70 (31.3)	χ^2 (2) = 1.035
CNY 100,001–200,000	120 (27.6)	76 (63.3)	44 (36.7)	p = 0.596
≥CNY 200,000	90 (20.8)	60 (66.7)	30 (33.3)	N = 434
Total floor of building n (%)				
6 floors and below	225 (48.8)	156 (69.3)	69 (30.7)	χ^2 (1) = 0.550
≥7 floors	236 (51.2)	156 (66.1)	80 (33.9)	p = 0.458
Floor area of unit n (%)				N = 461
50 m^2 and below	92 (20.3)	62 (67.4)	30 (32.6)	
51 m^2 to 90 m^2	162 (35.8)	114 (70.4)	48 (29.6)	χ^2 (3) = 3.880
91 m^2 to 120 m^2	109 (24.1)	76 (69.7)	33 (30.3)	p = 0.275
≥121 m^2	90 (19.8)	53 (58.9)	37 (41.1)	N = 453
Satisfaction of indoor comfort				
Dissatisfied	110 (23.8)	70 (70.0)	33 (30.0)	χ^2 (2) = 0.789
Fair	313 (67.6)	210 (67.1)	103 (32.9)	p = 0.674
Very satisfied	40 (8.6)	25 (62.5)	15 (37.5)	N = 463
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	104 (71.2)	42 (28.8)	χ^2 (2) = 11.345
General concerned	250 (54.8)	152 (60.8)	98 (39.2)	p = 0.003 **
Very concerned	60 (13.2)	49 (81.7)	11 (18.3)	N = 456
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	58 (78.4)	16 (21.6)	χ^2 (2) = 7.327
Heard about it	225 (48.0)	140 (62.2)	85 (37.8)	p = 0.026 *
Clearly understand the meaning	173 (36.3)	121 (69.9)	52 (30.1)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.7)	26 (81.3)	6 (18.8)	χ^2 (2) = 7.889
Positive	223 (47.7)	138 (61.9)	85 (38.1)	p = 0.019 *
Very positive	217 (45.6)	156 (71.9)	61 (28.1)	N = 472
Experience of renovation				
Non-renovated	378 (80.8)	252 (66.7)	126 (33.3)	χ^2 (1) = 0.655
Renovated	90 (19.2)	64 (71.1)	26 (28.9)	p = 0.418
				N = 468

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

Table A12. Comparison of preference to include neighborhood committee members in the working group by socio-demographic characteristics, building features, and behavioral factors.

	Overall Sample	Preference to Include Neighborhood Committee Members in the Working Group		Chi-Square Tests of Independence
		No	Yes	
Gender n (%)				
Male	229 (51.9)	165 (72.1)	64 (27.9)	χ^2 (1) = 0.268
Female	212 (48.1)	148 (69.8)	64 (30.2)	p = 0.604
Age in years n (%)				N = 441
30 and below	200 (45.9)	147 (73.5)	53 (26.5)	χ^2 (2) = 6.969
31–50	136 (31.2)	103 (75.7)	33 (24.3)	p = 0.031 *
≥51	100 (22.9)	61 (61.0)	39 (39.0)	N = 436
Occupation status n (%)				
Student	90 (21.5)	66 (73.3)	24 (26.7)	χ^2 (2) = 3.380
Full-time worker	249 (59.4)	181 (72.7)	68 (27.3)	p = 0.185
Unemployed/Retired	80 (19.1)	50 (62.5)	30 (37.5)	N = 419
Highest education level n (%)				
College and below	130 (30.0)	85 (65.4)	45 (34.6)	χ^2 (2) = 3.272
Undergraduate	183 (42.3)	129 (70.5)	54 (29.5)	p = 0.195
Postgraduate and above	120 (27.7)	91 (75.8)	29 (24.2)	N = 433
Annual household income n (%)				
CNY 100,000 and below	224 (51.6)	154 (68.8)	70 (31.3)	χ^2 (2) = 2.078
CNY 100,001–200,000	120 (27.6)	83 (69.2)	37 (30.8)	p = 0.354
≥CNY 200,000	90 (20.8)	69 (76.7)	21 (23.3)	N = 434
Total floor of building n (%)				
6 floors and below	225 (48.8)	153 (68.0)	72 (32.0)	χ^2 (1) = 1.320
≥7 floors	236 (51.2)	172 (72.9)	64 (27.1)	p = 0.251
Floor area of unit n (%)				N = 461
50 m^2 and below	92 (20.3)	56 (60.9)	36 (39.1)	
51 m^2 to 90 m^2	162 (35.8)	112 (69.1)	50 (30.9)	χ^2 (3) = 8.946
91 m^2 to 120 m^2	109 (24.1)	87 (79.8)	22 (20.2)	p = 0.030 *
≥121 m^2	90 (19.8)	65 (72.2)	25 (27.8)	N = 453
Satisfaction of indoor comfort				
Dissatisfied	110 (23.8)	80 (72.7)	30 (27.3)	χ^2 (2) = 3.926
Fair	313 (67.6)	213 (68.1)	100 (31.9)	p = 0.140
Very satisfied	40 (8.6)	33 (82.5)	7 (17.5)	N = 463
Awareness of environmental protection issues				
Unconcerned	146 (32.0)	98 (67.1)	48 (32.9)	χ^2 (2) = 1.864
General concerned	250 (54.8)	176 (70.4)	74 (29.6)	p = 0.394
Very concerned	60 (13.2)	46 (76.7)	14 (23.3)	N = 456
Knowledge of energy efficient renovation				
Not at all	74 (15.7)	57 (77.0)	17 (23.0)	χ^2 (2) = 1.997
Heard about it	225 (48.0)	154 (68.4)	71 (31.6)	p = 0.368
Clearly understand the meaning	173 (36.3)	123 (71.1)	50 (28.9)	N = 471
Attitude towards energy efficient renovation				
Neutral or negative	32 (6.7)	20 (62.5)	12 (37.5)	χ^2 (2) = 1.088
Positive	223 (47.7)	158 (70.9)	65 (29.1)	p = 0.580
Very positive	217 (45.6)	155 (71.4)	62 (28.6)	N = 472
Experience of renovation				
Non-renovated	378 (80.8)	274 (72.5)	104 (27.5)	χ^2 (1) = 4.505
Renovated	90 (19.2)	55 (61.1)	35 (38.9)	p = 0.034 *
				N = 468

Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001.

References

1. IEA. World Energy Outlook 2017: China. Available online: https://www.iea.org/reports/world-energy-outlook-2017-china (accessed on 10 August 2021).
2. Li, B.; Yao, R. Urbanisation and its impact on building energy consumption and efficiency in China. *Renew. Energy* **2009**, *34*, 1994–1998. [CrossRef]
3. State Council. Regulation on Energy Conservation in Civil Buildings. Available online: http://www.gov.cn/zwgk/2008-08/07/content_1067038.htm (accessed on 10 August 2021).
4. Liu, W.; Zhang, J.; Bluemling, B.; Mol, A.P.; Wang, C. Public participation in energy saving retrofitting of residential buildings in China. *Appl. Energy* **2015**, *147*, 287–296. [CrossRef]
5. Huang, C.; Ma, J.; Song, K. Homeowners' willingness to make investment in energy efficiency retrofit of residential buildings in China and its influencing factors. *Energies* **2021**, *14*, 1260. [CrossRef]
6. Liang, J.; Li, B.; Wu, Y.; Yao, R. An investigation of the existing situation and trends in building energy efficiency management in China. *Energy Build.* **2007**, *39*, 1098–1106. [CrossRef]
7. Huang, J.; Sun, Q. The triple dilemma of the governance of the old community in the city. *J. Wuhan Univ. Technol.* **2016**, *29*, 27–33.
8. MOHURD. *Guideline for Energy Efficient Renovation in Residential Buildings*; MOHURD (Ministry of Housing and Urban-Rural Development): Beijing, China, 2012.
9. State Council. *Guideline for Comprehensively Promoting the Transformation of Old Communities in Urban and Rural Areas*; The State Council of the People's Republic of China: Beijing, China, 2020.
10. Ouyang, J.; Hokao, K. Energy-saving potential by improving occupants' behavior in urban residential sector in Hangzhou City, China. *Energy Build.* **2009**, *41*, 711–720. [CrossRef]
11. Liu, Y.; Liu, T.; Ye, S.; Liu, Y. Cost-benefit analysis for Energy Efficiency Retrofit of existing buildings: A case study in China. *J. Clean. Prod.* **2018**, *177*, 493–506. [CrossRef]
12. Wang, X.; Lu, M.; Mao, W.; Ouyang, J.; Zhou, B.; Yang, Y. Improving benefit-cost analysis to overcome financing difficulties in promoting energy-efficient renovation of existing residential buildings in China. *Appl. Energy* **2015**, *141*, 119–130. [CrossRef]
13. Zhong, Y.; Cai, W.; Wu, Y.; Ren, H. Incentive mechanism design for the residential building energy efficiency improvement of heating zones in North China. *Energy Policy* **2009**, *37*, 2119–2123. [CrossRef]
14. Jia, L.; Qian, Q.K.; Meijer, F.; Visscher, H. Stakeholders' risk perception: A perspective for proactive risk management in residential building energy retrofits in China. *Sustainability* **2020**, *12*, 2832. [CrossRef]
15. Qi, Y.; Qian, Q.K.; Meijer, F.M.; Visscher, H.J. Identification of quality failures in building energy renovation projects in Northern China. *Sustainability* **2019**, *11*, 4203. [CrossRef]
16. MOHURD; NDRC; MOF; NEA. *Guideline for Promoting Clean Heating Supply in Urban-Rural Area in the Northern Heating Region*; MOHURD (Ministry of Housing and Urban-Rural Development); NDRC (National Development and Reform Commission); MOF (Ministry of Finance); NEA (National Energy Administration): Beijing, China, 2017.
17. Bray, D. Building 'community': New strategies of governance in urban China. *Econ. Soc.* **2006**, *35*, 530–549. [CrossRef]
18. Lixin, Y.; Ke, C.; Xiaoying, C.; Yueling, S.; Xiaoqing, C.; Ye, H. Analysis of social vulnerability of residential community to hazards in Tianjin, China. *Nat. Hazards* **2017**, *87*, 1223–1243. [CrossRef]
19. MOHURD. *Requirement of Intelligent Technology for Energy-Saving Retrofit of Existing Building*; MOHURD (Ministry of Housing and Urban-Rural Development): Beijing, China, 2020.
20. Lu, S.; Feng, W.; Kong, X.; Wu, Y. Analysis and case studies of residential heat metering and energy-efficiency retrofits in China's northern heating region. *Renew. Sustain. Energy Rev.* **2014**, *38*, 765–774. [CrossRef]
21. Miezis, M.; Zvaigznitis, K.; Stancioff, N.; Soeftestad, L. Climate change and buildings energy efficiency—The key role of residents. *Environ. Clim. Technol.* **2016**, *17*, 30–43. [CrossRef]
22. Yuming, L. Study on Economic Incentive for Improving Energy Efficiency of Existing Residential Buildings. Ph.D. Thesis, Bejing Jiaotong University, Beijing, China, 2009. (In Chinese).
23. Valciukas, S. Practice of Multi-Family Housing Renovations. Comparative Study of Stockholm and Vilnius on Motivating, Driving and Bottleneck Factors. Master's Thesis, KTH Royal Institute of Technology, Stockholm, Sweden, 2012.
24. Hiller, C. Tenant involvement for a successful renovation. In Proceedings of the Conference of Passivhus Norden 2013, Goteborg, Sweden, 15–17 October 2013.
25. Bieksa, D.; Siupsinskas, G.; Martinaitis, V.; Jaraminiene, E. Energy efficiency challenges in multi-apartment building renovation in Lithuania. *J. Civ. Eng. Manag.* **2011**, *17*, 467–475. [CrossRef]
26. Paiho, S.; Hedman, A.; Abdurafikov, R.; Hoang, H.; Sepponen, M.; Kouhia, I.; Meinander, M. Energy saving potentials of Moscow apartment buildings in residential districts. *Energy Build.* **2013**, *66*, 706–713. [CrossRef]
27. Paiho, S.; Abdurafikov, R.; Hedman, A.; Hoang, H.; Kouhia, I.; Meinander, M.; Sepponen, M. Energy-Efficient Renovation of Moscow Apartment Buildings and Residential Districts. Available online: https://www.vttresearch.com/sites/default/files/pdf/technology/2013/T82.pdf (accessed on 10 August 2021).
28. Chileshe, N.; Khatib, J.M.; Farah, M. The perceptions of tenants in the refurbishment of tower blocks. *Facilities* **2013**, *31*, 119–137. [CrossRef]
29. Mirakyan, A.; de Guio, R. Integrated energy planning in cities and territories: A review of methods and tools. *Renew. Sustain. Energy Rev.* **2013**, *22*, 289–297. [CrossRef]

30. Pedersen, E.; Blomsterberg, A. Your house is my home: Tenant perceptions of major renovations including energy-efficiency measures in multifamily housing in a Swedish residential area. *J. Eng. Archit.* **2016**, *4*, 17–34.
31. Hogberg, L.; Lind, H.; Grange, K. Incentives for improving energy efficiency when renovating large-scale housing estates: A case study of the Swedish Million Homes Programme. *Sustainability* **2009**, *1*, 1349–1365. [CrossRef]
32. Holm, M.G. Service management in housing refurbishment: A theoretical approach. *Constr. Manag. Econ.* **2000**, *18*, 525–533. [CrossRef]
33. Ma, J.; Qian, Q.; Visscher, H.; Song, K. Reluctance to adopt energy efficiency renovation in Chinese households—A behavioural perspective. In Proceedings of the 40th IAEE International Conference, Singapore, 18–21 June 2017.
34. Guo, B.; Zhou, R.; Li, Y. Systemic research on owner participation in old residential community management from the perspective of identity—A case study of a typical old residential community in Xi'an, China. *Syst. Pr. Action Res.* **2020**. [CrossRef]
35. Zhou, M. Debating the state in private housing neighborhoods: The governance of Homeowners' Associations in Urban Shanghai. *Int. J. Urban Reg. Res.* **2014**, *38*, 1849–1866. [CrossRef]
36. Wang, F. Determinants of the effectiveness of Chinese homeowner associations in solving neighborhood issues. *Urban Aff. Rev.* **2014**, *50*, 311–339. [CrossRef]
37. Tang, B. Deliberation and governance in Chinese middle-class neighborhoods. *Jpn. J. Political Sci.* **2018**, *19*, 663–677. [CrossRef]
38. Dong, W.; Wang, Z. A comparative study on the public participation of government leading and community leading urban regeneration—A case study of Beijing old city conserve regeneration practice. *J. Hum. Settl. West China* **2017**, *32*, 19–25.
39. Kuai, Y.; Bai, M. Multiple stakeholders gaming in old neighborhood renovation decision-making: Beijing example. *Planners* **2015**, *31*, 48–54.
40. Wilson, C.; Crane, L.; Chryssochoidis, G. Why do homeowners renovate energy efficiently? Contrasting perspectives and implications for policy. *Energy Res. Soc. Sci.* **2015**, *7*, 12–22. [CrossRef]
41. Harzing, A.-W.; Brown, M.; Koster, K.; Zhao, S. Response style differences in cross-national research. *Manag. Int. Rev.* **2012**, *52*, 341–363. [CrossRef]
42. Wang, Z.; Zhang, B.; Yin, J.; Zhang, Y. Determinants and policy implications for household electricity-saving behaviour: Evidence from Beijing, China. *Energy Policy* **2011**, *39*, 3550–3557. [CrossRef]
43. Boland, A.; Zhu, J. Public participation in China's green communities: Mobilizing memories and structuring incentives. *Geoforum* **2012**, *43*, 147–157. [CrossRef]
44. Turkington, R.; Wheelaghan, S. The Refurbishment of High-Rise Local Authority Housing Blocks: Involving the Tenants—Lessons from the UK. Available online: https://www.jstor.org/stable/44180735?seq=1#metadata_info_tab_contents (accessed on 10 August 2021).
45. Wang, F.; Yin, H.; Zhou, Z. The adoption of bottom-up governance in China's homeowner associations. *Manag. Organ. Rev.* **2012**, *8*, 559–583. [CrossRef]
46. He, S. Homeowner associations and neighborhood governance in Guangzhou, China. *Eurasian Geogr. Econ.* **2015**, *56*, 260–284. [CrossRef]
47. Guan, T.; Liu, T. Participatory representation in a Non-Western context: The case of Homeowner Associations in Beijing. *Urban Aff. Rev.* **2021**, *57*, 984–1014. [CrossRef]