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Influence of Residential Photovoltaic Promotion Policy on Installation Intention in Typical Regions of China

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Abstract: Increasing the popularity of distributed photovoltaic technology among Chinese residents is of great significance to achieve the dual carbon goal (emission peak and carbon neutrality). In this study, we collected 1424 questionnaire samples and used PLS-SEM for group modeling and comparative analysis of bungalow and building residents. The results show that living conditions, costs, risks of installation, maintenance, and economic efficiency are the five significant influencing factors for residents to decide whether to install a distributed residential photovoltaic equipment. Compared with building residents, bungalow residents tend to feel more concerned about the cost and risk of residential photovoltaic equipment during installation, maintenance, and use. On the other hand, bungalow residents show greater sensitivity to the corresponding photovoltaic promotion policies. By contrast, building residents pay more attention to the direct benefit created by the installation of residential photovoltaic equipment. Therefore, adopting the strategy from bungalow residents to building residents could help promote the distributed photovoltaic system progressively. As for the subsidy decline, more attention shall be paid to the progress of a gradual reduction of the subsidies. It is advisable to pay attention to integrating the upstream and downstream industry chains of the distributed photovoltaic systems, thus reducing the concern of residents about the difficulty in installing, maintaining, and protecting the distributed photovoltaic equipment. By clarifying the different impacts of promotion policies on the demand side, this study provides a practical reference for the further adjustment made to distributed photovoltaic promotion policies.

Keywords: subsidy policy; guidance policy; technology acceptance model; residential photovoltaic; attitude-behavior-context model

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1. Introduction

Clean energy is the core to achieve the dual carbon goal [1,2], which is one of the basic goals for achieving global sustainable development [3]. Currently, distributed photovoltaics play a vital role in supporting the energy transition, meeting the needs of changing lifestyles and enabling the global low-carbon transition [4]. However, due to the influence of relevant policies, the rapid development of distributed photovoltaics relying on subsidies is pointed out to be unsustainable [5]. Globally, residential emissions accounted for two-thirds of human greenhouse gas emissions in 2020 [6]. With the rapid economic development and lifestyle changes, household energy consumption accounts for about 30% of the world [7], and it is expected that reducing greenhouse gas emissions while meeting energy demand will be a challenge [8]. Governments around the world have been advocating the adoption of green lifestyles [9]. China is the world's largest electricity generator and carbon dioxide emitter. In 2020, China produced around 26.1% of global electricity and emitted about 28.2% of global greenhouse gases [10]. As a result, China proposed the dual carbon goal (emission peak and carbon neutrality). In order to achieve low-carbon sustainable development, China needs to increase the proportion of clean energy in energy consumption. Therefore, China gives priority to using clean energy in power generation rather than highly polluting and non-renewable coal [11,12]. The advantages of residential photovoltaic system in green power generation lie in its abundant photothermic resources, stable power generation, convenient installation, and miniaturization, which has attracted the wide attention of many people [4,13]. Photovoltaic solar panels for home use can convert abundant solar energy directly into electricity without pollution. Households can not only use the electricity they produce for free, eliminating the need to buy electricity from the state, but also sell the excess electricity back to the grid, earning a profit and qualifying for government subsidies [14,15]. This kind of scheme is not only beneficial to residents who install residential photovoltaic but also beneficial to environmental protection and sustainable development and is considered as an innovative solution to achieve China's emission reduction targets and mitigate climate change [16,17]. Therefore, this paper focuses on the promotion of residential photovoltaic in China.

Roers pointed out that the adoption of innovative products involves a series of psychological changes and behavioral responses experienced by consumers from the initial understanding of relevant information to the final decision on whether to adopt the product [18,19]. For energy-based innovative products, Park et al. [20] found that whether such new product will cause damage to residents' lives and properties is an important reason for whether they can accept the product. Ahmad et al. [21] further explained this change with the TAM model, arguing that whether residents adopt residential photovoltaic products will also be affected by perceived usefulness and perceived ease of use. Drumond et al. [22] pointed out that policy promotion is the main driving force for the current residents to install distributed photovoltaics, and due to the important position of residential photovoltaic in the national energy field, policy promotion has never been absent in the field of residential photovoltaic promotion. In the past ten years, especially after 2012, subsidy policies flooded the Chinese market to stimulate the market diffusion of photovoltaic products, and the role of subsidy policies in the field of residential photovoltaic is particularly important [23]. Since residential photovoltaic is a newly introduced product, Chinese consumers have a low awareness of residential photovoltaic, and such a product faces an immature consumer market, which may lead to various concerns and risk perceptions of consumers. Therefore, the Chinese government requires that no less than 50% of the total roof area of government buildings should install photovoltaic power generators, striving to generate publicity and demonstration effects by the installation on government departments [24]. The research of Martinez-Poveda et al. [25] showed that the government's guidance policy can reduce residents' perceived risk of new products and radically reform at the same time, prevent the spread of misinformation in the market, and improve users' cognitive level.

Recent studies have begun to focus on factors affecting the diffusion of residential photovoltaic products, but the research background is mainly based on the situation in developed countries [26,27]. The installation of a residential photovoltaic system requires a suitable installation site, usually a flat roof or a gently sloping roof, and the user has the independent right to use it [28,29]. Developed European countries and the United States have large areas and small populations. The houses are mainly single-family houses with scattered layouts, which provide good installation conditions for residential photovoltaic systems. For example, by 2021, due to its superior natural and living conditions, distributed photovoltaic power generation in Australia accounted for 12% of the total solar power generation, far ahead of other countries [30], while the houses inhabited by Chinese residents are mainly single-family buildings (herein uniformly defined as bungalows) and urban apartment communities (herein uniformly defined as buildings). According to Regulations of the People's Republic of China on property management, the installation of photovoltaic outbuildings in bungalows' only requires the consent of the owner of the single-family building, while to install in buildings requires the consent of the owners' congress of the community [31]. The interference of such external factors will make the impact of policies on the diffusion of residential photovoltaic products likely to vary according to living conditions. Unfortunately, although the number of households in China has increased to about 500 million, by the end of 2021, only 873,000 pieces of photovoltaic equipment have been installed, and the installation rate is only 1.7% [32], far from reaching the policy target [24]. This situation showed that for policy-driven residential photovoltaic products, it is a complicated process for residents to accept. According to “the National Development and Reform Commission on new energy feed-in tariff policy and relevant particulars in 2021 (exposure draft)” [33], it was specified that 2021 is the last year to enjoy central financial subsidies for new household distributed photovoltaic projects, which indicates that residential photovoltaic subsidies have begun to decline, which will increase the uncertainty in the future promotion of residential photovoltaic. Therefore, it is necessary to clarify the complex mechanism of action between the promotion of policies and residential rooftop photovoltaics installation.

In view of the above situation, we urgently need to understand the following questions: Can the two types of policies effectively stimulate residents’ willingness to install? Will residents with different living conditions (bungalows and buildings) respond differently to the policy? Such issues have important practical significance for the subsequent adjustment of photovoltaic promotion policies and can further enrich the theoretical understanding of “obstacles to the popularization of renewable energy technology”.

The current research mainly analyzes the influencing factors affecting residents’ installation of residential photovoltaic from two aspects: macro-policy factors [34–36] and micro-psychological factors [13,37,38]. Few studies combine policy and psychological factors and distinguish the actual living conditions of Chinese residents to analyze the specific path of policy factors affecting residents’ willingness to install through psychological factors. Among them, subsidy policy and guidance policy are the main variables in this study, which are difficult to measure directly. The mechanism of subsidy policy is to stimulate the willingness to accept residential photovoltaic of residents through interest incentives. When users feel the benefits brought by the product, the user’s acceptance of the product can be improved [39]. Therefore, this study refers to the practice of Kim et al. [26] and regards the perceived benefit as a proxy variable of subsidy policy. The guidance policy is to shorten the distance between the actor’s cognition and action through the ways of guidance and demonstration to provide information and knowledge [40]. The stronger the guidance felt by the actor, the stronger the willingness to act [41]. Therefore, this study adopts the approach of Teng et al. [42], using perception guidance as a substitute variable for guidance policies. Taking these two as the core points affecting the installation intention of consumers as well as the evaluation of their effectiveness, these form an important basis for the government to adjust the new round of policy in the promotion of distributed photovoltaic power generation.

The rest of this research is organized as follows. Section 2 reviews the relevant literature. Section 3 presents the study design. Section 4 presents the results and discussions. Section 5 gives conclusions, policy implication and presents the limitations of this study and future work plans.

2. Literature Review

For the sake of supporting the development of China’s photovoltaic industry, the Chinese government issued the “Interim Measures for the Management of Financial Subsidies for the Golden Sun Pilot Project” in 2009 [43], which opened the history of subsidies for distributed photovoltaics by the central finance and achieved remarkable results. The cumulative installed capacity of residential photovoltaic in China increased from 0.93 GW in 2016 to 20 GW in 2020 [44]. China has a large population, and although the penetration rate of residential photovoltaic in the total population is still not high, the substantial growth of installed capacity has made the Chinese government realize that China’s photovoltaic industry has developed to a certain level, and it needs to rely on market forces to further promote China’s photovoltaics [45]. Therefore, in 2021, “the National Development and Reform Commission on new energy feed-in tariff policy and relevant particulars in

2021 (exposure draft)" [33] was issued, which specified that 2021 is the last year to enjoy central financial subsidies for new household distributed photovoltaic projects, which indicates that residential photovoltaic subsidies have begun to decline. In addition, the China National Energy Administration issued the "Notice on Submitting the Pilot Program for Rooftop Distributed Photovoltaic Development of the Whole County (City, District)" on 24 June 2021 [24], which requires no less than 50% of the total roof area of government buildings should install photovoltaic power generation, striving to generate demonstration effect by the installation on government departments. It means that the Chinese government will no longer rely solely on subsidy policies to promote residential photovoltaic, and publicity and demonstration are also an option for its promotion policy. The combination of multiple policies may become a strategy for the Chinese government to promote residential photovoltaic in the future.

Extensive studies have analyzed the impact of photovoltaic promotion policies from a macro level. Luo et al. [34] reviewed the development process of photovoltaic promotion policies in China from the mid-1990s to 2013 and found that policy implementation was characterized by instability. Wüstenhagen et al. [35] found that the financial gap caused by subsidies would hinder the further promotion of distributed photovoltaics. Liu et al. [46] explored the different effects of different types of policies on the green innovation of enterprises with different property rights types. Zhang et al. [36] evaluated the installation potential of residential photovoltaics in rural China and the corresponding economic and environmental effects. The results of the above research provide a reference for the formulation and implementation of China's photovoltaic policies, but the residential sector is the main decision-making subject, and the policy itself constitutes the decision-making scenario of the residential sector [47]. Such research results can hardly explain how policies affect residential decisions. There are also many studies that focus on the promotion of residential photovoltaic products in developing countries. Different theories have been adopted to test the influencing factors that affect residents' installation intention, such as technology diffusion (DOI model) [13], theory of planned behavior (TPB model) [37], and value-belief-norm (VBN) theory [38], etc. The focus of such research is to explore the intrinsic factors that affect residents' installation intention from the perspectives of values, perceptions, attitudes, etc. However, for distributed photovoltaic equipment, on one hand, it has the attributes of technological products [21], and on the other hand, it needs the promotion of policy elements [48], and different decision-making scenarios will inevitably affect users' decision making [49]. In the past 20 years, China has experienced a process of rapid urbanization under the drive of real estate and high-speed infrastructure [50]. In this process, a large number of residents moved from bungalows to buildings. Differences in living conditions will also affect residents' acceptance of photovoltaic technology. The effect of the policy is also affected by the residential scene [51]. Such studies can hardly integrate with the actual living scenarios of current Chinese residents and cannot explain the differential effects of policy effects in different scenarios.

In order to achieve the dual carbon goal and achieve sustainable development, China's residential photovoltaics are strongly supported by national policies [52]. Previous study has pointed out that for emerging industries with high investment risk and low user acceptance, such as photovoltaic power generation, the government's package of policy support plans on the consumer side, such as low-interest subsidies, can significantly reduce user cost risks and ensure investment income. This can turn potential photovoltaic followers into actual photovoltaic adopters, which can effectively promote the increase of photovoltaic system installation rate to a large extent [53]. In addition, publicity, guidance, and information services can also cooperate with subsidy policies to shorten the psychological distance between residents and photovoltaic power generation and guides residents' choice of residential photovoltaics [7]. China's residential photovoltaic subsidy policy was initiated in 2009 together with various publicity and guidance policies to promote the development of China's residential photovoltaics [18]. On the basis of the opinions on improving the "System, Mechanism, and Policy Measures for Energy Green and Low-

Carbon Transformation", issued by the National Energy Administration of the National Development and Reform Commission of China [54], at present, residential photovoltaic power generation can be sold to power grid enterprises. It means the electricity produced by the residential photovoltaic power generation equipment can be used either for self-use or for sale. The local governments' subsidies for distributed photovoltaic power generation can not only subsidize the sales price but also subsidize the installation cost.

The above literature analyzed residents' willingness to purchase residential PV from the perspective of users' consumption psychology [13,37], while others analyzed the impacting factors of residents' installation of residential PV equipment from the perspective of users' environmental protection concerns [38]. The mentioned literature all asserted that whether users are willing to adopt a residential PV system is controlled by their inner will. Some scholars also studied the impact of policies on residential consumption and the installation of residential PV equipment from the external policy's perspective [7,53]. However, according to the opinions of Steg [47] and Guagnano et al. [55], human behavior is the result of the joint action of both the external environment and internal psychology, among which policy measures belong to one of the external environments [47]. Therefore, some scholars have combined the above theories and analyzed the mechanism by which government policies ultimately affect users' consumption decisions through influencing users' internal psychology. For example, Park et al. studied how electricity pricing policies and government training affect residents' willingness to adopt the smart grid based on the extended TAM theory [20], and Kim et al. studied the influence of government's quality control policy on PV equipment and industrial policy (reducing the cost of PV equipment through industrial policy) on the adoption of PV equipment by Korean residents [26]. Based on the above literature, this paper establishes a structural equation model to measure the influence mechanism of China's subsidy policies and guidance policies on residents' willingness to install residential PV.

Specifically, the method of group comparison was adopted to build a policy path model. This research discusses the main policy driving factors and influencing factors of residents' purchase and installation intention, which is a comprehensive understanding of residents' purchase and installation intention. The research results provide theoretical inspiration and practical reference for comprehensively understanding the mutual influence relationship between perception and purchase as well as installation intention of distributed photovoltaic power generation system. Existing studies use different terms to define the behavior of residents toward installing and using distributed photovoltaic power generation equipment. The commonly used terms include residential photovoltaic [22], building-integrated photovoltaic (BIPV) [56], and roof-mounted photovoltaic (RMPV), etc. [57]. The common ground among the three is the installation of distributed photovoltaic power generation devices on buildings through BAPV or BIPV technology. BIPV technology focuses on the technical link between photovoltaic equipment and buildings [58], while RMPV often appears in the context of macro analysis. The roof in the area is regarded as a resource that can install distributed photovoltaic power generation equipment to evaluate the potential of installing solar power generation equipment in the area [59], while residential photovoltaic emphasizes domestic attributes. That is, solar photovoltaic panels are installed on the top of home buildings, generate electricity through the photoelectric effect, and then convert the direct current into alternating current through the inverter [60]. In order to avoid ambiguity and define the boundaries of the study, considering the purpose of this study, this definition is adopted in this paper.

3. Empirical Strategy

3.1. Theoretical Foundation

TAM is a model proposed by Davis in 1989 when he used rational behavior theory to study users' acceptance of information systems [61]. Since then, this model has been used by many scholars to study the behavior of innovative technology use from different perspectives. The model proposes to use perceived usefulness and perceived ease of use as the main measures of technology acceptance behavior. Perceived usefulness refers to individuals' belief that using a particular application system can improve work performance; that is, users feel that using this innovative technology can bring convenience to their work or life. Perceived ease of use refers to individuals' belief that using or the ease with which a system or innovative technology is mastered. Davis et al. [61] used this model to explain and predict the acceptance of residential photovoltaic systems by residents.

Perceived risk originates from the theory of customer perceived value, which is often used in the field of consumer behavior [62]. Park et al. [21] believed that perceived risk (PR) also plays an important role in users' acceptance of new technological products and used it to predict the user acceptance of the smart grid. Residential photovoltaics and home smart grids both belong to the category of energy technology products. Therefore, this study adopts Park et al.'s definition of perceived risks: residents' inner concerns when choosing new technology products, including concerns that the products will not meet the user's purpose and product quality, the loss of time, economy, money, social evaluation, and other aspects to users caused by the lack of after-sales service, etc.

The attitude-behavior-context model believes that changes in individuals' perceptions of external scenes will affect individuals' internal psychological cognition and further affect behavior, which can be used to understand the impact of individual policy perceptions on behavior [63,64]. The TAM assumes that external variables directly affect perceived usefulness and perceived ease of use, but the model itself does not strictly specify external variables [61]. Muhammad-Sukki found that government policy is an important factor in the implementation of residential photovoltaic power generation [48]. In view of this, this paper extends the TAM based on the above elements and focuses on analyzing the impact of subsidy policies and guidance policies on perceived usefulness, perceived ease of use, and perceived risks. This study also explores the mediating role of perceived usefulness, perceived ease of use, and perceived risks between the two policies and residential photovoltaic installation intention, which provides inspiration for research on residential photovoltaic installation intention.

3.2. Hypotheses

3.2.1. Perceived Usefulness (PU)

As mentioned above, this paper draws on the definition of perceived usefulness from the TAM. The specific definition of perceived usefulness here is the user's perception that the residential photovoltaic system can improve their work performance and provide convenience in life. In accordance with the research of Ahmad et al. [21], the stronger the perceived usefulness of the residential photovoltaic system, the stronger the intention to purchase and install it, so the following hypothesis is put forward:

Hypothesis 1 (H1). *Perceived usefulness is positively correlated with installation intention.*

3.2.2. Perceived Ease of Use (PEOU)

Referring to the definition of Davis [62], the PEOU here is specifically defined as the user's subjective perception of the difficulty of using and maintaining a residential photovoltaic system. With regard to the research of Ahmad et al. [21], the stronger the residents' PEOU of residential photovoltaic system, the more easily its purchase and installation behavior can be implemented, so the following hypothesis is made:

Hypothesis 2 (H2). *PEOU is positively correlated with installation intention.*

3.2.3. Perceived Risk (PR)

Park et al. [20] found that PR has a significant impact on whether residents choose to install and use a smart grid. When residents have concerns and think that purchasing, installing, and using a certain technology product will bring them some kind of loss, they will not purchase. As smart grid and residential photovoltaic power generation systems are both energy technology products and have similar attributes, this study draws on Park's definition and puts forward the following hypothesis:

Hypothesis 3 (H3). *PR is negatively related to installation intention.*

3.2.4. Perceived Benefit (PB)

At present, some local governments in various parts of China still implement subsidy policies for residents to install residential photovoltaic power generation and connect them to the grid. The essence of subsidy is an incentive mechanism implemented to promote the popularity of residential photovoltaic installations. When users feel the benefits brought by the product, the users' acceptance of the product can be effectively improved [65]. Therefore, the PB is used to measure the effect of government subsidy policies in the research. Park's research believes that saving electricity bills for residents or bringing benefits can improve residents' perceived usefulness of smart grids [20]. The PB is similar to this hypothesis. Furthermore, it can be seen that the subsidy policy brings additional benefits to residents. Park defined the user's PR when purchasing and adopting new products as a psychological perception. For example, when purchasing technology products, users may encounter the failure of purchasing due to information asymmetry or various risks such as time costs, operational risks, financial risks, personal injury, and loss of honor during the use process due to the lack of user knowledge and skills [20]. Since the risks include financial risk, we believe that the PB brought by the subsidy policy can hedge the financial risks of users' psychology. Thus, the PB has a certain degree of influence on the PR. Mole's research found that the use cost of mobility as a service will affect the user's PEOU, which includes economic cost, time cost, and operation cost. Cost-saving can improve users' perception of ease of use, thereby improving users' acceptance of mobility as a service [39]. Therefore, we speculate that subsidy policies can reduce the economic cost of residential photovoltaics for residents, thereby generating a positive impact on the perceived ease of use. In summary, the following hypotheses are put forward:

Hypothesis 4 (H4). *PB is positively correlated with installation intention.*

Hypothesis 5 (H5). *PB is positively correlated with perceived usefulness.*

Hypothesis 6 (H6). *PB is positively correlated with perceived ease of use.*

Hypothesis 7 (H7). *PB is negatively correlated with perceived risks.*

3.2.5. Perceived Guide (PG)

In addition to the subsidy policy, the Chinese government also uses publicity, demonstration, and other policies to guide residents to install residential PV. For example, it requires party and government organizations at all levels to take the lead in installing residential photovoltaic systems, thus trying to create an exemplary effect to guide residents to generate installation intention. The resulting effect of such publicity and demonstration strategies is defined as a PG in this study, that is, the effect of government publicity, demonstration, and guide subjectively felt by residents. Wang believes that when users feel the guiding role of publicity and demonstration, it can shorten the psychological distance between residents and residential photovoltaic products and help residents to generate installation intention [7]. Phang believes that an effective publicity strategy can allow potential users to obtain more information about new products, but after users obtain more product information through publicity strategies, it can improve the PU and PEOU of the product [66]. Research by Martinez-Poveda et al. shows that publicity and guidance strategies can reduce residents' PR of new products and can curb the spread of misinformation in the market and improve users' awareness [25]. Based on the above content, the following hypotheses are put forward:

Hypothesis 8 (H8). *PG is positively correlated with installation intention.*

Hypothesis 9 (H9). *PG is positively correlated with PU.*

Hypothesis 10 (H10). *PG is positively correlated with PEOU.*

Hypothesis 11 (H11). *PG is negatively correlated with PR.*

3.2.6. Hypothesis of Mediating Role

In terms of the above hypotheses in Sections 3.2.1–3.2.5, the following hypotheses can be derived and tested together:

Hypothesis 12 (H12). *PB can positively affect residents' installation intention through perceived usefulness (according to H1 and H5).*

Hypothesis 13 (H13). *PB can positively influence residents' installation intention through PEOU (according to H1 and H9).*

Hypothesis 14 (H14). *PB can positively affect residents' installation intention through PR (according to H2 and H6).*

Hypothesis 15 (H15). *PG can positively affect residents' installation intention through PU (according to H2 and H10).*

Hypothesis 16 (H16). *PG can positively influence residents' installation intention through PEOU (according to H3 and H7).*

Hypothesis 17 (H17). *PG can positively affect residents' installation intention through PR (according to H3 and H11).*

Hypothesis 18 (H18). *The overall mediating effect of PG on residents' purchase and installation intention is significant (according to H12, H14, and H16).*

Hypothesis 19 (H19). *PB has a significant mediating effect on residents' purchase and installation intention (according to H13, H15, and H17).*

Based on the above theoretical deduction, this paper obtains the research model as shown in Figure 1:

3.3. Questionnaire Design

A total of six constructs are involved in this research. The questionnaire items involved in all the constructs refer to the existing literature. The first draft of the questionnaire was verified by two full-time teachers and sent to the energy management department for further improvement. In the demographics section, the income mainly refers to the average annual residential income. The main variables are measured using the Likert 5-point scale, and the measurement scales are shown in Table 1 Among them, PB refers to Stern [67] and Kim et al. [26], and PG refers to the scales used by Wang et al. [7] and Teng et al. [42]; scale use, perceived usefulness, PEOU, and installation intention refer to Davis [62] and Ahmad [21], while scale development and PR refer to Park [20]. The construct of PR is negatively correlated with the installation intention (H3), PB (H7), and PG (H11), while the structural equation model requires the formative indicators of all latent variables to be consistent in measurement with other latent variables [68]. Therefore, it is necessary to do the opposite for the item of PR. After obtaining the scores of the questionnaire items, we changed 5 points to 1 point, 4 points to 2 points, 3 points to unchanged, 2 points to 4 points, and 1 point to 5 points. All the items are shown in Table 1. In order to distinguish the samples in the research, the living condition item was added to the questionnaire items through the choice "The house I live in for a long time is (bungalow, building)".

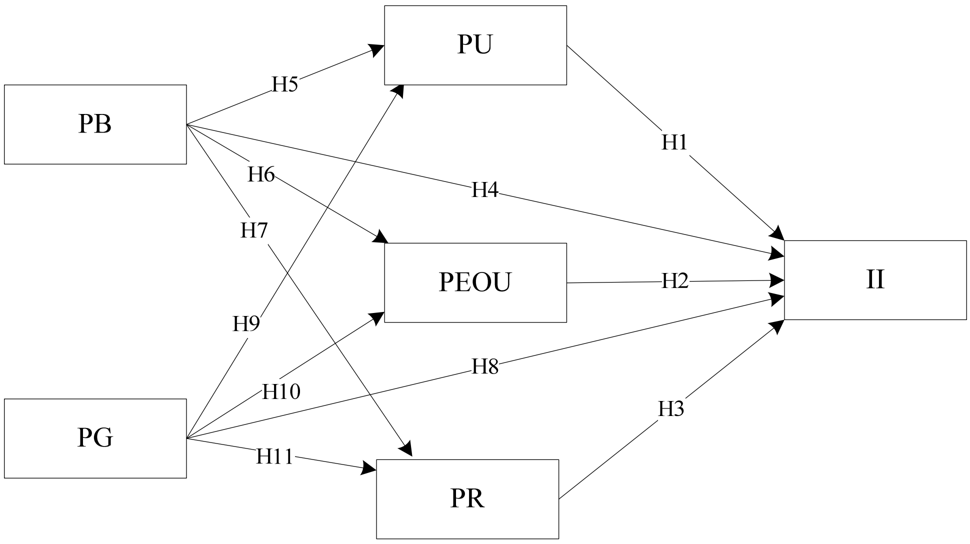

Figure 1. Research model. Notes: II, installation intention; PU, perceived usefulness; PEOU, perceived ease of use; PR, perceived risk; PB, perceived benefit; PG, perceived guide.

3.4. Data

In virtue of the statistics of the China Photovoltaic Industry Association in 2021, as of July 2021, the top three provinces included in the national financial subsidy scale of residential photovoltaic projects in 2021 are Hebei (3.8548 million kW, accounting for 40.17% of the national total), Shandong (3.0992 million kW, accounting for 32.30%), and Henan (1.1571 million kW, accounting for 12.06%), with the three provinces accounting for 84.53% of the national total [69]. Hence, Hebei, Henan, and Shandong have certain user base of residential photovoltaic power generation equipment. This can provide a good sample source for the comparative analysis of purchasing decision drivers and purchasing intention among different groups in this paper. Constrained by the anti-pandemic policy in mainland China, the commonly used residential surveys were not feasible. Therefore, this study chose to conduct an online questionnaire survey and target the residents of the three typical provinces in China with random questionnaires by locking their IP addresses. In order to improve the answering rate of the questionnaire, an answering lottery was used to motivate answering questions. We also conducted an online pre-questionnaire test of 50 respondents, which provided an opportunity for the re-examination of the formal survey and improved sample quality. The survey was conducted in February 2022 for a period of 30 days. A total of 1531 questionnaires were obtained from the survey. After processing the missing data and removing outliers, 1424 samples were finally obtained for analysis, with an effective sample rate of 93.07%.

Table 1. Morphological equivalence assessment.

Variables	Items	Respondents of Bungalow Residents (n = 684)				Respondents of Building Residents (n = 740)			
		Factor Loading	Cronbach's α	CR	AVE	Factor Loading	Cronbach's α	CR	AVE
II			0.813	0.889	0.728		0.838	0.901	0.752
II1	I am interested in considering installing rooftop PV power generation equipment.	0.855				0.904			
II2	I am interested in persuading my family to install household PV power generation equipment for their homes.	0.860				0.842			
II3	I am willing to take the time to learn about photovoltaic equipment for home use information.	0.844				0.855			
PU			0.831	0.899	0.747		0.834	0.898	0.746
PU1	Using rooftop PV power generation equipment can save me electricity costs.	0.868				0.913			
PU2	Using rooftop PV power generation equipment can improve my life quality.	0.884				0.862			
PU3	The use of rooftop PV power generation equipment is conducive to reduce carbon emissions and achieve sustainable development.	0.841				0.813			
PEOU			0.782	0.835	0.564		0.800	0.855	0.600
PEOU1	It is very easy to use rooftop PV power generation equipment.	0.710				0.784			

Table 1. *Cont.*

Variables	Items	Respondents of Bungalow Residents (n = 684)				Respondents of Building Residents (n = 740)			
		Factor Loading	Cronbach's α	CR	AVE	Factor Loading	Cronbach's α	CR	AVE
PEOU3	It does not take much time to learn how to use rooftop PV power generation equipment.	0.801				0.828			
PEOU4	It does not take much time to learn how to maintain roof top PV power generation equipment.	0.897				0.861			
PR			0.810	0.887	0.723		0.799	0.878	0.707
PR1	I am worried about the stability of household PV power generation equipment.	0.861				0.898			
PR2	I am worried about the quality problem of household PV power generation equipment perhaps causing me economic losses.	0.841				0.858			
PR3	I am concerned that the quality of household PV power generation equipment will cause me personal injury.	0.850				0.762			
PB			0.831	0.898	0.747		0.815	0.889	0.728
PB1	The government subsidy for the distributed PV power generation equipment will make me decide to install it.	0.871				0.807			
PB2	The earned tariff for distributed PV power generation equipment was important to my choice of installation.	0.858				0.872			

Table 1. *Cont.*

Variables	Items	Respondents of Bungalow Residents (n = 684)				Respondents of Building Residents (n = 740)			
		Factor Loading	Cronbach's α	CR	AVE	Factor Loading	Cronbach's α	CR	AVE
PB3	Whether the government provides the distributed PV power generation equipment for free is important to my willingness to install it.	0.863				0.880			
PG			0.817	0.888	0.726		0.827	0.896	0.742
PG1	Good publicity will make me decide to install distributed PV power generation equipment.	0.884				0.837			
PG2	Knowing the pros and cons of installing distributed PV power generation equipment is important for me to choose an installation.	0.860				0.866			
PG3	Local party and government departments have installed a distributed system. The photovoltaic equipment is the one reason that drives me to install.	0.810				0.881			

Note: II, installation intention; PU, perceived usefulness; PEOU, perceived ease of use; PR, perceived risk; PB, perceived benefit; PG, perceived guide.

The basic properties of the samples are shown in Table 2 from the perspective of gender, age, and education level, there is no significant difference between the residents of the bungalows and the residents of the buildings. However, from the perspective of the average annual income, the respondents living in bungalows are below CNY 12,000 (accounting for 23.00%), CNY 12,001~30,000 (21.90%), CNY 30,001~50,000 (31.30%), CNY 50,001~100,000 (11.00%), and above CNY 100,001 (13.00%); respondents from buildings are below CNY 12,000 (5.40%), CNY 12,001~30,000 (9.90%), CNY 30,001~50,000 CNY (33.10%), CNY 50,001~100,000 (23.20%), and more than CNY 100,001 (28.40%). The comparative analysis shows that the respondents of building residents with higher average income accounted for a relatively large proportion. In China, most of the respondents in bungalows live in rural areas and urban-rural areas, while the building respondents mainly live in cities, while the income difference reflects the current situation of urban–rural binary difference.

Table 2. Sample structure.

Item	Attribute	Respondents of Bungalow Residents (n = 684)	Respondents of Building Residents (n = 740)	Total (n = 1424)
Gender	Male	344 (50.3%)	388 (52.40%)	732 (51.40%)
	Female	340 (49.7%)	352 (47.60%)	692 (48.60%)
Age	25~30 years	186 (27.20%)	259 (35.00%)	445 (31.30%)
	31~36 years	241 (35.2%)	216 (29.20%)	457 (32.10%)
	37~42 years	184 (26.90%)	161 (21.80%)	345 (24.20%)
	43 years and above	73 (10.70%)	104 (14.10%)	177 (12.40%)
Education level	Junior college and below	274 (42.91%)	299 (40.40%)	573 (41.20%)
	Undergraduate	374 (51.67%)	401 (54.20%)	775 (54.40%)
	Postgraduate and above	36 (5.52%)	40 (5.40%)	76 (5.30%)
Average annual income of family members	Below CNY 12,000	157 (23.00%)	40 (5.40%)	197 (13.80%)
	CNY 12,001~30,000	150 (21.90%)	73 (9.90%)	223 (15.70%)
	CNY 30,001~50,000	213 (31.10%)	245 (33.10%)	458 (32.30%)
	CNY 50,001~100,000	75 (11.00%)	172 (23.20%)	247 (17.30%)
	CNY Above 100,001	89 (13.00%)	210 (28.40%)	299 (21.00%)

The purpose of this study is to use extended TAM to explore the impact path of two policies (subsidy policy and guidance policy) on residents' intention to install photovoltaic technology for different residential living conditions (bungalows, buildings). Mediating variables are as follows: PU and PEOU are derived from the TAM [61], PR is derived from the Theory of Perceived Value [62], PB comes from the research of Kim et al. [26], and PG comes from Wang et al. [7] and Teng et al. [42]. The entire model is shown in Figure 1. The integration of external and internal factors is intuitive and efficient.

As the PB of subsidy policy and PG of guidance policy is included in the research, the TAM model is extended to increase the PR of constructs. This study aims to build a new model by expanding and integrating different constructs. Thus, it is an exploratory study to explore the effect mechanism of government guidance policy on residents' installation intentions. Chin et al. [70] and Hair et al. [71] showed that partial least square method–structural equation modeling (PLS-SEM) is suitable for exploratory research. This study adopts the PLS-SEM method to analyze the data.

4. Result and Discussion

4.1. Measurement Invariance Assessment of Composite Model (MICOM)

Measurement invariance assessment of composite model (MICOM) is a research method based on group comparisons of structural equation models. The purpose is to test whether two different groups in the group comparison will have different understandings of the questionnaire items due to differences in culture, identity, race, etc., in the questionnaire test. If different groups have different understandings of the questionnaire, it means there might be other more disturbing terms affecting the results of the comparative study [72]. Based on the above problems, MICOM was developed as is mainly documented in the works of Henseler et al. [72] and Hair et al. [73]. The purpose of using this method is to determine whether the questionnaire items are comparable in different groups. There are three specific steps of this method: The first is morphological equivalence evaluation, which is also called structural invariance test. In practice, when different groups have the same structure and factor parameter coefficients, the invariance of their structure must be confirmed. Using the Cronbach'α coefficient and the internal consistency reliability with a combined reliability greater than or equal to 0.7, the convergence reliability and discriminate reliability with a mean variance extraction value greater than or equal to 0.5, and the heterogeneity–elemental ratio analysis less than 0.9 to evaluate. The main test data in this study are summarized in Tables 2–4. The measured results are that the two groups of data are structurally consistent, which means there is no significant difference in the model structure between the two groups of samples. The second step is factor invariance evaluation, also called component invariance evaluation. The purpose of this step is to assess whether the components in the model (six constructs in this case) have invariance in different groups. This step constructs a "C value", which is the "Original Correlation" in Table 5. The closer the C value is to 1, the more homogeneous the corresponding elements (constructs) of the two groups are. Specifically, it can be determined by the "combined *p*-value". The test results are in Table 5. The results also showed that the evaluation of the invariance of the factors of the two groups meets the requirements. The third step is the mean and variance test. The purpose of this step is to determine whether there is a difference between the two groups of samples, which has a certain degree of repeatability with the second step, that is, by testing the mean and variance of the construct in the two samples to determine whether the construct is different in the two groups of samples. This step needs to be used in conjunction with theoretical evidence, which is not a necessary step. This study did not further use the third step for testing because of China's 3000 years of unified cultural tradition, and there is no evidence to prove living in buildings and living in bungalows will produce cultural and identity differences. Considering that this test is not the subject of this research, the first two steps are enough to compare the data of bungalow and building residents, so the further third step test was not selected.

Table 3. Discriminant reliability analysis.

Variables	**Respondents of Bungalow Residents (n = 684)**						**Respondents of Bungalow Residents (n = 740)**					
	II	**PB**	**PEOU**	**PG**	**PR**	**PU**	**II**	**PB**	**PEOU**	**PG**	**PR**	**PU**
II	0.853						0.867					
PB	0.084	0.864					0.197	0.853				
PEOU	−0.071	−0.008	0.751				0.077	0.045	0.775			
PG	0.074	0.101	−0.001	0.852			−0.017	0.197	−0.040	0.861		
PR	0.268	0.153	0.015	0.165	0.851		0.008	0.193	−0.086	0.193	0.841	
PU	0.182	0.126	−0.084	0.023	0.059	0.864	0.077	0.092	−0.022	0.241	0.077	0.864

Note: The value on the diagonal is the square root of AVE, and the remaining values are the correlation coefficients with other factors.

4.2. Inspection of Structural Model

First, the variance inflation factor (VIF) was used to assess multicollinearity between exogenous structures. The VIF values in this paper are all less than 3.30, indicating that there is no problem with multicollinearity [74]. Second, R^2 is used to assess the predictive power of the model, and Q^2 is used to assess the predictive correlation of endogenous structures. The related values indicate that the predictive correlation of the model has been achieved, as shown in Table 6. The standardized root mean square residual (SRMR) is used to assess the fit of the overall model. SRMR < 0.1 is acceptable, and a more stringent standard is SRMR < 0.08 [75]. In the study, SRMR bungalow = 0.054, and SRMR building = 0.053, so the fitting result of this model is acceptable. Referring to the suggestion of Qian et al. [76], a bootstrap mediation test and statistical analysis were used, and 5000 samples were selected to estimate a 95% confidence interval for the mediation effect test. The results are shown in Table 6 and Figures 2 and 3.

Table 4. Heterogeneous–elemental ratio analysis.

Variables	Respondents of Bungalow Residents (n = 684)						Respondents of Building Residents (n = 740)					
	II	**PB**	**PEOU**	**PG**	**PR**	**PU**	**II**	**PB**	**PEOU**	**PG**	**PR**	**PU**
II												
PB	0.101						0.232					
PEOU	0.075	0.040					0.076	0.054				
PG	0.098	0.123	0.065				0.035	0.248	0.054			
PR	0.331	0.185	0.048	0.194			0.037	0.224	0.112	0.227		
PU	0.217	0.150	0.103	0.045	0.071		0.089	0.120	0.049	0.276	0.100	

Table 5. Factor invariance analysis.

	Original Correlation	Correlation Permutation Mean	5.00%	Permutation p-Values
II	0.998	0.998	0.993	0.472
PB	0.997	0.998	0.994	0.197
PEOU	0.992	0.642	0.064	0.992
PG	0.993	0.998	0.994	0.060
PR	0.994	0.998	0.994	0.052
PU	0.997	0.997	0.992	0.357

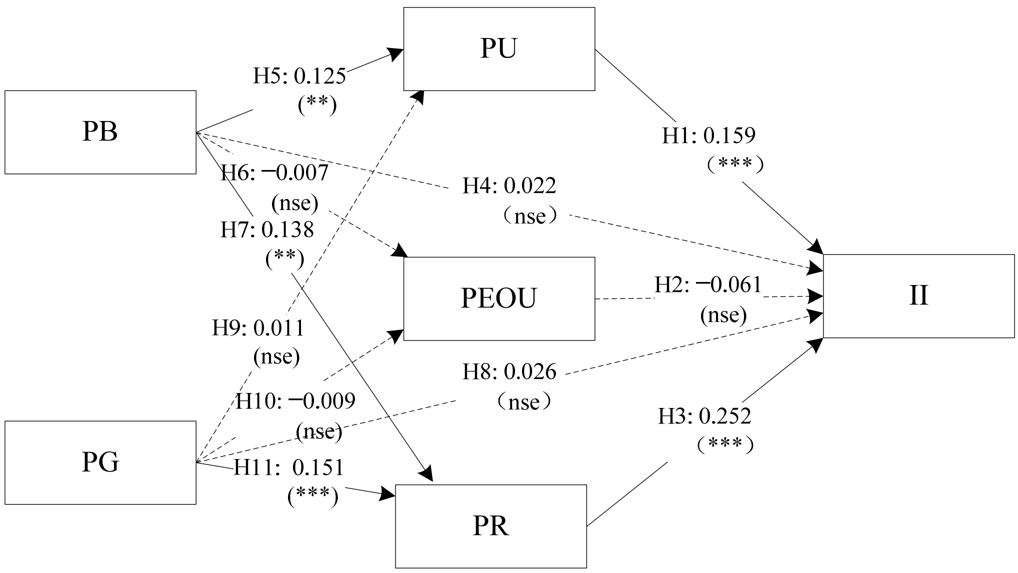

Figure 2. Influencing factors and paths of distributed photovoltaic system installation willingness of respondents of bungalow residents. Note 1: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; nse, no significant effect. Note 2: ⟶ shows the path is significant; ⇢ shows the path is not significant.

Table 6. Comparative analysis of the respondents of bungalow and building residents.

Hypothesis	Influence Path	Respondents of Bungalow Residents (n = 684)			Respondents of Building Residents (n = 740)			Comparative Analysis	
		Path Coefficient (Significance)	*p*-Value	Hypothesis Test Results	Path Coefficient (Significance)	*p*-Value	Hypothesis Test Results	Path Difference	*p*-Value
H1	PU ⟶ II	0.159 (***)	0.000	s	0.078 (*)	0.046	s	0.081 (nse)	0.142
H2	PEOU ⟶ II	−0.061 (nse)	0.203	ns	0.063 (nse)	0.179	ns	−0.124 (nse)	0.074
H3	PR ⟶ II	0.252 (***)	0.000	s	−0.035 (nse)	0.379	ns	0.287 (***)	0.000
H4	PB ⟶ II	0.022 (nse)	0.557	ns	0.207 (***)	0.000	s	−0.185 (***)	0.000
H5	PB ⟶ PU	0.125 (**)	0.006	s	0.046 (nse)	0.305	ns	0.079 (nse)	0.220
H6	PB ⟶ PEOU	−0.007 (nse)	0.908	ns	0.055 (nse)	0.203	ns	−0.063 (nse)	0.411
H7	PB ⟶ PR	0.138 (**)	0.002	s	0.162 (***)	0.000	s	−0.024 (ns)	0.682
H8	PG ⟶ II	0.026 (nse)	0.532	ns	−0.067 (nse)	0.092	ns	0.093 (nse)	0.103
H9	PG ⟶ PU	0.011 (nse)	0.808	ns	0.232 (***)	0.000	s	−0.222 (***)	0.000
H10	PG ⟶ PEOU	−0.009 (nse)	0.918	ns	−0.055 (nse)	0.227	ns	0.046 (nse)	0.616
H11	PG ⟶ PR	0.151 (***)	0.000	s	0.161 (***)	0.000	s	0.010 (nse)	0.855
H12	PB ⟶ PU ⟶ II	0.020 (*)	0.023	ns	0.003 (nse)	0.376	ns	0.016 (nse)	0.091
H13	PB ⟶ PEOU ⟶ II	0.001 (nse)	0.912	ns	−0.002 (nse)	0.828	ns	0.003 (nse)	0.593
H14	PB ⟶ PR ⟶ II	0.035 (**)	0.007	s	−0.006 (ns)	0.403	ns	0.040 (**)	0.004
H15	PG ⟶ PU ⟶ II	0.002 (nse)	0.816	ns	0.018 (nse)	0.057	ns	−0.016 (nse)	0.177

Table 6. *Cont.*

Hypothesis	Influence Path	Respondents of Bungalow Residents (n = 684)			Respondents of Building Residents (n = 740)			Comparative Analysis	
		Path Coefficient (Significance)	*p*-Value	Hypothesis Test Results	Path Coefficient (Significance)	*p*-Value	Hypothesis Test Results	Path Difference	*p*-Value
H16	PG ⟶ PEOU ⟶ II	0.001 (nse)	0.919	ns	0.003 (nse)	0.371	ns	−0.002 (nse)	0.531
H17	PG ⟶ PR ⟶ II	0.038 (***)	0.000	s	−0.006 (nse)	0.419	ns	0.044 (***)	0.000
H18	PB ⟶ II	0.055 (***)	0.000	s	0.001 (nse)	0.879	ns	0.054 (**)	0.002
H19	PG ⟶ II	0.040 (**)	0.005	s	0.009 (nse)	0.460	ns	0.031 (nse)	0.096
R^2									
	PU	0.240			0.200				
	PEOU	0.180			0.160				
	PR	0.220			0.230				
	II	0.393			0.401				
Q^2									
	PU	0.218			0.130				
	PEOU	0.142			0.121				
	PR	0.256			0.219				
	II	0.302			0.303				

Note 1: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; nse, no significant effect. Note 2: Path difference = β bungalow-β building. Note 3: s, support, ns, non-support.

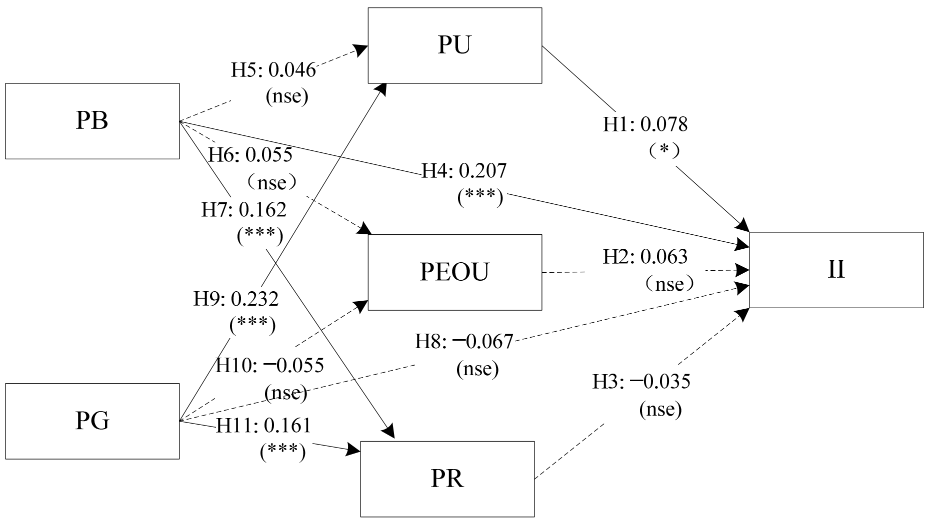

Figure 3. Influencing factors and paths of distributed photovoltaic system installation willingness of respondents of building residents. Note 1: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; nse, no significant effect. Note 2: ——→ shows the path is significant; - - - -→ shows the path is not significant.

4.3. Hypothesis Test Results of Bungalow Residents

As shown in Table 7 and Figure 2, for the respondents of bungalow residents, the supported hypotheses are H1 (β = 0.159, $p < 0.001$), H3 (β = 0.252, $p < 0.001$), H5 (β = 0.125, $p < 0.05$), H7 (β = 0.138, $p < 0.01$), H11 (β = 0.151, $p < 0.001$), H12 (β = 0.020, $p < 0.05$), H14 (β = 0.035, $p < 0.01$), H17 (β = 0.038, $p < 0.001$), H18 (β = 0.055, $p < 0.001$), and H19 (β = 0.040, $p < 0.01$).

The results of the above hypothesis test can be interpreted as follows. Because the respondents who are bungalow residents have independent control over their own roofs and walls, once they install distributed photovoltaic equipment in the above-mentioned areas, they need to manage it themselves. Although they can make independent decisions about whether their own roofs and walls are installed with photovoltaics, they also need to undertake more management obligations. Therefore, they are more concerned about the risk of installation and use (H3 is significant), and PB and PG can only indirectly affect residents' installation intention through PU and PB (H12, H14, and H17 are significant), and the total indirect total effect of the two policies is also significant (H18 and H19 are significant). Moreover, isolated policies cannot directly promote residents' installation intention (H4 and H8 are not significant). This indicates that bungalow residents not only care about benefits but also worry about the costs of management, maintenance, and operations when making decisions. In terms of the effect on PU and PR, the PB has a positive impact on PU and PR (both H5 and H7 are significant), while PG only has a significant effect on PR but has no effect on PU (significant in H11, not significant in H9 and H15), indicating that the effect of PB (subsidy policy) is greater than that of PG (publicity and demonstration) (H18 > H19). This further indicates that, for now, interest stimulation is still the key factor for bungalow residents to decide whether to install residential photovoltaics.

For bungalow residents, PU has an impact on residents' installation intention (H1), while the impact of PEOU is not significant (H2). Not only that, but PB and PG also have no significant impact on PEOU (H6, H10), nor do they affect residents' installation intention through PEOU (H13, H16). It can be explained as follows. Since the electricity produced by residential photovoltaics can not only be sold on the grid but also can be used by themselves, the bungalow residents will also consider the practicality (PU) of installing residential photovoltaics when considering whether to install them, that is, choosing electricity self-use. In addition, it is compared to the risk (PR) that needs to be taken, so PU and PR are the internal factors that drive bungalow residents to make installation decisions.

Table 7. Hypothesis test results of respondents of bungalow residents.

Respondents of Bungalow Residents (n = 684)					
Hypothesis	**Influence Path**	**Path Coefficient (Significance)**	***t*-Value**	***p*-Value**	**Hypothesis Test Results**
H1	PU ⟶ II	0.159 (***)	4.191	0.000	support
H2	PEOU ⟶ II	−0.061 (nse)	1.274	0.203	non-support
H3	PR ⟶ II	0.252 (***)	6.863	0.000	support
H4	PB ⟶ II	0.022 (nse)	0.588	0.557	non-support
H5	PB ⟶ PU	0.125 (**)	2.736	0.006	support
H6	PB ⟶ PEOU	−0.007 (nse)	0.115	0.908	non-support
H7	PB ⟶ PR	0.138 (**)	3.087	0.002	support
H8	PG ⟶ II	0.026 (nse)	0.626	0.532	non-support
H9	PG ⟶ PU	0.011 (nse)	0.244	0.808	non-support
H10	PG ⟶ PEOU	−0.009 (nse)	0.103	0.918	non-support
H11	PG ⟶ PR	0.151 (***)	3.746	0.000	support
H12	PB ⟶ PU ⟶ II	0.020 (*)	2.268	0.023	non-support
H13	PB ⟶ PEOU ⟶ II	0.001 (nse)	0.110	0.912	non-support
H14	PB ⟶ PR ⟶ II	0.035 (**)	2.700	0.007	support
H15	PG ⟶ PU ⟶ II	0.002 (nse)	0.232	0.816	non-support
H16	PG ⟶ PEOU ⟶ II	0.001 (nse)	0.102	0.919	non-support
H17	PG ⟶ PR ⟶ II	0.038 (***)	3.218	0.000	support
H18	PB ⟶ II (Total indirect effect)	0.055 (***)	3.673	0.000	support
H19	PG ⟶ II (Total indirect effect)	0.040 (**)	2.802	0.005	support

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; nse, no significant effect.

4.4. Hypothesis Test Results of Building Residents

As shown in Table 8 and Figure 3, for the building respondents, the hypotheses that can be supported are H1 (β = 0.078, $p < 0.05$), H4 (β = 0.270, $p < 0.001$), H7 (β = 0.162, $p < 0.001$), H9 (β = 0.232, $p < 0.001$), and H11 (β = 0.161, $p < 0.001$).

Table 8. Hypothesis test results of respondents of building residents.

Respondents of Building Residents (n = 740)					
Hypothesis	**Influence Path**	**Path Coefficient (Significance)**	***t*-Value**	***p*-Value**	**Hypothesis Test Results**
H1	PU ⟶ II	0.078 (*)	1.999	0.046	support
H2	PEOU ⟶ II	0.063 (nse)	1.343	0.179	non-support
H3	PR ⟶ II	−0.035 (nse)	0.879	0.379	non-support
H4	PB ⟶ II	0.207 (***)	5.411	0.000	support
H5	PB ⟶ PU	0.046 (nse)	1.027	0.305	support
H6	PB ⟶ PEOU	0.055 (nse)	1.273	0.203	non-support
H7	PB ⟶ PR	0.162 (***)	4.130	0.000	support
H8	PG ⟶ II	−0.067 (nse)	1.688	0.092	non-support
H9	PG ⟶ PU	0.232 (***)	5.790	0.000	support
H10	PG ⟶ PEOU	−0.055 (nse)	1.209	0.227	non-support
H11	PG ⟶ PR	0.161 (***)	4.078	0.000	support
H12	PB ⟶ PU ⟶ II	0.003 (nse)	0.886	0.376	non-support
H13	PB ⟶ PEOU ⟶ II	−0.002 (nse)	0.217	0.828	non-support
H14	PB ⟶ PR ⟶ II	−0.006 (nse)	0.837	0.403	non-support
H15	PG ⟶ PU ⟶ II	0.018 (nse)	1.900	0.057	non-support
H16	PG ⟶ PEOU ⟶ II	0.003 (nse)	0.895	0.371	non-support
H17	PG ⟶ PR ⟶ II	−0.006 (nse)	0.808	0.419	non-support
H18	PB ⟶ II (Total indirect effect)	0.001 (nse)	0.152	0.879	non-support
H19	PG ⟶ II (Total indirect effect)	0.009 (nse)	0.739	0.460	non-support

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; nse, no significant effect.

The interpretation of the above test results is as follows. The roof, walls, and other building resources belong to all owners in terms of ownership, and the decision of whether to install photovoltaic equipment on the roof and wall requires the collective decision of the owners' meeting. The building management is entrusted to the property management company, and a single owner does not need to bear the management responsibility but can indeed enjoy the benefits brought by residential photovoltaics. In this decision-making scenario, building residents do not care about PR (H3 is not significant), so PB and PG cannot indirectly promote building respondents' installation intention through PR (H14 and H17 are not significant). Building respondents only care about benefits, so PB and PG cannot indirectly affect residents' installation intention through PU (H12 and H15 are not significant). As a result, the two policies cannot produce totally indirect effects (H18 and H19 are not significant). On the contrary, PB can directly stimulate residents' installation intention (H4 is significant), while the direct effect of PG is not significant (H8 is not significant). For building residents, PB has no significant effect on PU (H5 is not significant), but it does have a positive impact on residents' PR (H7 is significant); PG has positive effects on PU and PR (H9 and H11 are significant) but cannot form an indirect policy effect. The explanation for this is that the building respondents believe that since a collective decision is required for installing residential photovoltaics, they believe that only when sufficient interests are driven can the scattered residents form a consensus.

Among the three mediating variables of PU, PEOU, and PR, the only variable that can affect the choice of building residents is PU (H1). In addition, PU has small effect on the installation intention of building residents (H1 ($\beta = 0.078$, $p < 0.05$)), which is less than that of bungalow residents (H1 ($\beta = 0.159$, $p < 0.001$)). It can be explained that once a residential PV system is installed on the rooftop and wall of an apartment building, the management and maintenance work is often undertaken by the property company, and the apartment owner only needs to pay the property fee. Moreover, for building residents, decision making is often collective decision making, where responsibilities and risks are borne by all apartment owners, and the risk that a single owner needs to bear is minimal. Therefore, regardless of whether from the perspective of residential PV operation and management or from the perspective of decision-making responsibility, a single building resident does not have to bear too much responsibility and risk. Therefore, the impact of PR on the installation intention is not significant (H3 is not significant).

4.5. Results of Comparative Analysis

As shown in Table 9 the comparison shows that the paths with more significance for the respondents of bungalow than building residents are H3 ($\Delta\beta = 0.287$, $p < 0.001$), H14 ($\Delta\beta = 0.040$, $p < 0.01$), H17 ($\Delta\beta = 0.044$, $p < 0.001$), and H18 ($\Delta\beta = 0.054$, $p < 0.01$); the paths that are more significant for building residents than for bungalow residents are H4 ($\Delta\beta = -0.185$, $p < 0.001$) and H9 ($\Delta\beta = -0.222$, $p < 0.001$).

The path difference of the two types of respondents is analyzed here. Since the bungalow respondents are more sensitive to the PR ($H3_{bungalow} > H3_{building}$), the PB and PG are also more likely to affect the bungalow respondents through the PR ($H14_{bungalow} > H14_{building}$, $H17_{bungalow} > H17_{building}$). As mentioned above, since the building respondents do not have to directly undertake the responsibility of managing residential photovoltaic equipment, the effect of PB is more direct. By contrast, for bungalow residents, residential photovoltaic equipment needs to be managed by themselves, so they have more concerns. This results in the need for the PB to be transmitted to the installation intention through the PU and PR. The final result is that the total indirect effect of bungalow residents on PB is greater than that of building residents ($H18_{bungalow} > H18_{building}$). On the contrary, since the building respondents place more importance on the benefits brought by the installation of residential photovoltaics, the PB has a more positive impact on them ($H4_{building} > H4_{bungalow}$). As for the impact of PG on PU, it is greater for the building respondents than the bungalow respondents ($H9_{building} > H9_{bungalow}$). It can be explained that the current publicity and guidance policies are mainly to first install residential appliances in the office spaces of party and government organizations and public institutions. Most of these places are buildings, so the building respondents are more likely to empathize with such guidance and perceive its usefulness.

Table 9. Comparative analysis results.

Comparative Analysis					
Hypothesis	**Influence Path**	**Bungalows' Path Coefficient (Significance)**	**Buildings' Path Coefficient (Significance)**	**Path Difference**	***p*-Value**
H1	PU ⟶ II	0.159 (***)	0.078 (*)	0.081 (nse)	0.142
H2	PEOU ⟶ II	−0.061 (nse)	0.063 (nse)	−0.124 (nse)	0.074
H3	PR ⟶ II	0.252 (***)	−0.035 (nse)	0.287 (***)	0.000
H4	PB ⟶ II	0.022 (nse)	0.207 (***)	−0.185 (***)	0.000
H5	PB ⟶ PU	0.125 (**)	0.046 (nse)	0.079 (nse)	0.220
H6	PB ⟶ PEOU	−0.007 (nse)	0.055 (nse)	−0.063 (nse)	0.411
H7	PB ⟶ PR	0.138 (**)	0.162 (***)	−0.024 (nse)	0.682
H8	PG ⟶ II	0.026 (nse)	−0.067 (nse)	0.093 (nse)	0.103
H9	PG ⟶ PU	0.011 (nse)	0.232 (***)	−0.222 (***)	0.000
H10	PG ⟶ PEOU	−0.009 (nse)	−0.055 (nse)	0.046 (nse)	0.616
H11	PG ⟶ PR	0.151 (***)	0.161 (***)	0.010 (nse)	0.855
H12	PB ⟶ PU ⟶ II	0.020 (*)	0.003 (nse)	0.016 (nse)	0.091
H13	PB ⟶ PEOU ⟶ II	0.001 (nse)	−0.002 (nse)	0.003 (nse)	0.593
H14	PB ⟶ PR ⟶ II	0.035 (**)	−0.006 (nse)	0.040 (**)	0.004
H15	PG ⟶ PU ⟶ II	0.002 (nse)	0.018 (nse)	−0.016 (nse)	0.177
H16	PG ⟶ PEOU ⟶ II	0.001 (nse)	0.003 (nse)	−0.002 (nse)	0.531
H17	PG ⟶ PR ⟶ II	0.038 (***)	−0.006 (nse)	0.044 (***)	0.000
H18	PB ⟶ II (Total indirect effect)	0.055 (***)	0.001 (nse)	0.054 (**)	0.002
H19	PG ⟶ II (Total indirect effect)	0.040 (**)	0.009 (nse)	0.031 (nse)	0.096

Note 1: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; nse, no significant effect. Note 2: Path difference = $\beta_{\text{bungalows}}$-$\beta_{\text{buildings}}$.

Regardless of the respondents of building or bungalow residents, it was found that the PU has different degrees of influence on the installation intention, while the PEOU has no significant effect. Hess et al. [77] divided the context of user acceptance of new products into two categories, i.e., hedonic context and utilitarian context. The so-called hedonic context means that for products that mainly provide customers with utility satisfaction, customers mainly make decisions in a hedonistic context. For example, for a new online game, PEOU has a greater impact on user acceptance than PU. The utilitarian context refers to products that mainly provide customers with convenience, efficiency and benefits. For example, for transportation, computers, and other products, the effect of PEOU is higher than that of PEOU. Therefore, we believe that whether residents of bungalows or buildings choose to install residential PV equipment depends on whether the equipment can provide more convenience, efficiency, and benefits for them.

From the above analysis, the difference between the two types of policies showed that the effect of the subsidy policy on the installation intention of the respondents of bungalow residents had an indirect impact ($H18_{bungalows} > H18_{buildings}$). In contrast, the effect of the subsidy policy on residents' installation intention of building residents is direct ($H4_{\ bungalows} < H4_{\ buildings}$). However, the influence of guiding policies on the installation intention of bungalow residents is indirect, and it is realized through PR ($H17_{\ bungalows}$ significant), while guiding policies do not have any direct or indirect influence on the installation intention of bungalow residents. The comparative experiment showed that different living conditions would affect the policies. Both the subsidy and the guidance policy have an indirect effect on the installation intention of the residents of bungalows, while for the residents of buildings, only the subsidy policy has a direct impact. In addition, the guidance policy does not affect the installation intention of the residents on both sides.

4.6. Influence of Demographic Characteristics on Installation Intention

To have a deeper understanding of the differences in the influence of individual characteristics of bungalow respondents and building respondents on their installation intention, this paper conducts an independent sample *t*-test and one-way ANOVA for the two groups, respectively. This study aims to explore the influences of gender, age, education, and average annual income of family members on the intention to install distributed photovoltaics. As shown in Table 10, different demographic characteristics have different effects on the installation intention of the two groups of respondents. For the bungalow respondents, gender, age, and education all have a positive effect on the installation intention. The explanation is that bungalow residents generally need to manage and maintain residential photovoltaic equipment themselves, and this kind of work requires a certain amount of physical strength. Males are better at this kind of technical work than females and have a higher degree of awareness of residential photovoltaic equipment. Similarly, older and more educated respondents have higher levels of work, life experience, and knowledge, so it is easier for them to overcome the risks and obstacles of installing, maintaining, and managing residential photovoltaic systems, resulting in a higher installation intention. The building respondents are affected by gender, education, and income. This can be explained as follows. Whether the building respondents choose to install is mainly affected by their interests and whether the residents of the community can agree on the installation intention. Moreover, males are more profitable than females, and residents with lower incomes are more likely to benefit from the installation of residential photovoltaic equipment, while residents with a bachelor's degree are more optimistic about whether the residents of the community can reach a consensus on installation intention.

4.7. Analysis of Research Results

Based on the above results, different living conditions lead to the difference in cost, use, and maintenance of photovoltaic equipment, which forms the different focus of the two living conditions.

The residential PV equipment for bungalow residents is installed at the family's own decision and managed by the family members themselves. The electricity produced by PV equipment can be for their own use or sold to grid companies. However, bungalow residents can experience worry about the risks that may occur during or after installation. Such risks include technical difficulties of future maintenance and the viability of sustainable gains.

Table 10. *t*-test and variance analysis of respondents of bungalow and building residents.

Variables	Items	Respondents of Bungalow Residents (n = 684)			Respondents of Building Residents (n = 740)		
		Mean	Standard Deviations	Sample Size	Mean	Standard Deviations	Sample Size
Gender	Male	3.269	1.213	344	3.292	1.201	388
	Female	3.062	1.205	340	3.439	1.171	352
	t-value	2.245			2.841		
	p-value	0.025			0.092		
Age	25–30 years	3.299	1.203	186	3.350	1.101	259
	31–36 years	3.089	1.157	241	3.364	1.242	216
	37–42 years	3.004	1.242	184	3.410	1.227	161
	43 years and above	3.493	1.269	73	3.314	1.241	104
	f-value	3.999			0.152		
	p-value	0.008			0.928		
Education Level	Technical school or below	3.297	1.209	274	3.181	1.221	299
	Undergraduate degree	3.104	1.231	374	3.515	1.167	401
	Master's degree or above	2.815	0.927	36	3.192	0.948	40
	f-value	3.616			7.318		
	p-value	0.027			0.001		
Income Level	CNY 12,000 or below	3.270	1.102	157	3.908	1.140	40
	CNY 12,001–30,000	3.096	1.217	150	3.210	1.232	73
	CNY 30,001–50,000	3.232	1.265	213	3.457	1.156	245
	CNY 50,001–100,000	3.009	1.217	75	3.391	1.202	210
	CNY 100,001 above	3.079	1.259	89	3.176	1.174	172
	f-value	0.999			4.184		
	p-value	0.407			0.002		

Therefore, for building residents, residential PV equipment is mainly installed on the rooftop and wall areas shared by the apartment owners. All apartment owners need to decide whether to agree to the installation collectively. After reaching a consensus through collective decision making, the installation and maintenance process will be handed over to the property company for subsequent management. Building residents and property companies are more like a cooperative relationship through which building residents provide assets (rooftop and wall areas), and property companies offer services, and they distribute the electricity revenue together from residential PV. Under such mode, PV equipment is unlikely to produce electricity for the residents' own use. Thus, building residents are more concerned about the success of collective decision making and the direct benefits of residential PV installation.

In view of the above differences, under the background of the gradual decline of PV subsidy policy in China, more alternative schemes can be designed based on the differences of concerns between the bungalow and building residents to promote residential PV.

To illustrate, the subsidy policy can be replaced by providing insurance services for bungalow residents. The form of insurance for residents to install the residential PV may produce part of the loss as a guarantee to dispel the doubts of bungalow residents about the installation risk. In order to encourage insurance companies to undertake such insurance, subsidies could be shifted from residents who install residential PV equipment to insurance companies that cover such residential PV installation insurance, and subsidies to insurance companies can be gradually reduced when residential PV technology, industry, and market operation become more mature. At the same time, the insurance scheme will be integrated into the promotion and publicity policies. The two methods will work together to improve the promotion of residential PV policies.

For building residents, the primary concerns are the possibility of the collective decision from all apartment owners, direct income from the installation of residential PV, income control, and how to spend the revenues. Thus, the government can provide more specific promotion strategies for apartment owners. For example, the building residents can be encouraged to install distributed PV equipment on the rooftop and wall areas of the building to benefit from electricity production. Third-party enterprises can also be encouraged to install distributed PV equipment on the rooftops and walls of the building to produce electricity. Apartment owners make collective decisions on whether to rent rooftop and wall areas. The rental income has the benefits of being stable, easy to calculate, and with relatively lower risk. The method of encouraging property companies or third-party enterprises to rent the building rooftop and wall areas is also a form of subsidy, and the subsidy can be gradually reduced after the operation mode gradually matures. The successful installation of residential PV could be a powerful case to strengthen the guidance policy and improve its promotion effect.

5. Conclusions

Promoting photovoltaics is a critical way to achieve the Chinese dual carbon goal, but the impact of the policy on residents' willingness to install is still unclear. In this paper, the TAM is extended, and a policy path model is constructed to clarify the significant influencing factors for the behavioral intention of residents to purchase and install distributed photovoltaics.

This research closely focused on the driving factors of installation intention, refers to the group comparison method [78], expands the Technology Acceptance Model (TAM), combines the elements of policy scenarios, builds up a policy path model, and analyzes the main policy driving factors of residents' installation intention. The influencing factors and policy action paths are discussed, which provides theoretical inspiration and practical reference for a comprehensive understanding of the interaction relationship between residents' perception of distributed photovoltaic power generation and their purchase and installation behavior intentions. The acting path of the current two policies to promote distributed photovoltaic power generation systems on residents' installation decisions is revealed, which is helpful for researchers to understand the complex mechanism between policy effects and residents' decision making. Through group comparison, the relevance between the attitude of residents with different living conditions to the distributed photovoltaic promotion policy and the installation intention is discussed, and different influences of the promotion policy on the demand-side groups are clarified, which provides support for the new round of adjustment of distributed photovoltaic power generation promotion policies and is a positive response to the National Energy Administration's relevant policy opinions on residential photovoltaic power generation.

The conclusion of the first question showed that both the subsidy policy and guidance policy can stimulate the residents' willingness to install to a certain extent: specifically, for the respondents of bungalow residents, the subsidy policy and the guidance policy have indirect effects on the residents' willingness to install (as shown in Table 7 and Figure 2: H12, H14, and H17 are all significant), and in the total indirect effect, the influence of subsidy policies is greater than that of guidance policy (H18 > H19). Therefore, both types of policies can stimulate residents' willingness to install. For the respondents of building residents, the subsidy policy can directly stimulate the residents' willingness to install (as shown in Table 8 and Figure 3: H4 is significant). In addition, through the comparative analysis in Section 4.5 of this study, different living conditions will have an impact on the effect of the policy. Specifically, the indirect effect of the subsidy policy for the bungalow residents is greater than that for the building residents (as shown in Table 9: $H18_{bungalow} > H18_{building}$), while the direct effect of the subsidy policy for the building residents is greater than that for the bungalow residents (as shown in Table 9: $H4_{bungalow} < H4_{building}$). In the total indirect effect of guidance policy on residents' willingness to install through PR, bungalow residents experience a greater effect than building residents (as shown in Table 9: $H17_{bungalow} > H17_{building}$). Based on the above conclusions, the subsidy policy plays an important role in the promotion of residential photovoltaic. The subsidy decline will inhibit the enthusiasm of residents to install rooftop photovoltaics, and at least from the perspective of the scope of action, the currently implemented guidance policy has no substitute for the subsidy policy. If the intensity of subsidy decline is too large, it will inevitably have a negative effect on the promotion of residential photovoltaic among Chinese residents.

As suggested by the research results, living conditions, costs, risks of installation, maintenance, and economic efficiency are the main influencing factors for residents to decide whether to install distributed photovoltaic systems or not. In order to further popularize the distributed photovoltaic systems among residents, the current promotion policies can be considered from the following perspectives. Firstly, it is necessary that the promotion of residential photovoltaics should start from easy to hard. The bungalow residents have the independent decision-making right to use the roofs or walls of their own houses, which means it is easier to convince them. The promotion can start from bungalow residents and then extend to building residents. When the installation rate of social residents reaches a certain level, it would be conducive to building a favorable atmosphere for the installation and use of distributed photovoltaic systems, thereby reducing the difficulty of further promotion. Secondly, in terms of cognition, most residents regard the installation of distributed photovoltaic systems as a form of investment. Thus, they pay close attention to the input–output ratio of such installation. Therefore, in the process of the gradual subsidy decline, is it necessary to apply careful control of the decline degree and process, and striking a balance should be sought between the penetration rate of distributed photovoltaics and the subsidy decline. Thirdly, in the long run, it is a general trend to withdraw subsidies for photovoltaic power generation. At present, photovoltaic power generation mainly comes from local subsidies. Therefore, this round of promotion should be taken advantage of to promote the deep development of the entire photovoltaic industry, reduce its technical risks and costs, and enhance the availability of photovoltaic equipment and accessories for residents. In this way, we can improve the convenience of the installation, maintenance, and maintenance of distributed photovoltaics and offset the vested interests of photovoltaic subsidies in the context of the photovoltaic subsidy decline. In the formulation and implementation of policies, more flexible measures should be taken according to the real problems of the bungalow and building residents in installing residential PV equipment and strive to ensure the progress of promotion work.

Due to the limitations of research conditions, the following defects are unavoidable in this study: First, as the data in this study only come from Hebei, Shandong, and Henan provinces of China, with the progress of photovoltaic technology and the popularization of residential PV across the country, the representativeness of data will be weakened. Secondly, due to the impact of epidemic management policies, this study collected data by issuing online questionnaires. As middle-aged and elderly people are not accustomed to answering questionnaire questions using mobile phones and other communication tools, respondents aged over 43 accounted for only 10.7% of the total number of samples. According to the Chinese seventh census data released in 2021, people aged 60 and above account for 18.7% of the total population, and those aged 65 and above account for 13.5% of the total population [79]. However, there is a significant difference between the older and younger generations in their attitude towards emerging scientific and technological products [80]. Therefore, the data of this study may not fully reflect the attitude and opinion of the older generation towards the residential photovoltaic system. This is an inevitable problem caused by the use of online questionnaires to collect data at the current stage. In the future research, we will try our best to use both online and offline questionnaires, interviews, etc., to conduct further research to reflect the opinions of respondents with different demographic characteristics in the research to improve the "extrapolation validity" of research findings.

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References

1. Lin, B.Q.; Li, Z. Towards world's low carbon development: The role of clean energy. *Appl. Energy* **2022**, *307*, 118160. [CrossRef]
2. Xu, B.; Chen, J. How to achieve a low-carbon transition in the heavy industry? A nonlinear perspective. *Renew. Sustain. Energy Rev.* **2021**, *140*, 110708. [CrossRef]
3. Dubey, P.K.; Singh, A.; Chaurasia, R.; Pandey, K.K.; Singh, S. Fostering Nature-Based Solutions for Ecorestoration and Attaining United Nations Sustainable Development Goals. *J. Clean Prod.* **2021**, *298*, 126680. [CrossRef]
4. Hancevic, P.I.; Nuñez, H.M.; Rosellon, J. Distributed photovoltaic power generation: Possibilities, benefits, and challenges for a widespread application in the Mexican residential sector. *Energy Policy* **2017**, *110*, 478–489. [CrossRef]
5. Adamo, I.D.; Falcone, P.M.; Gastaldi, M.; Morone, P. The economic viability of photovoltaic systems in public buildings: Evidence from Italy. *Energy* **2020**, *207*, 118316.
6. Capstick, S.; Wang, S.; Khosla, R. *Bridging the Gap—The Role of Equitable Low-Carbon Lifestyles (UNEP Emissions Gap Report 2020)*; United Nations: New York, NY, USA, 2020.
7. Wang, X.; Zheng, Y.; Jiang, Z.; Tao, Z. Influence Mechanism of Subsidy Policy on Household Photovoltaic Purchase Intention under an Urban-Rural Divide in China. *Energy* **2021**, *220*, 119750. [CrossRef]
8. Qadir, S.; Dosmagambet, Y. CAREC energy corridor: Opportunities, challenges, and IMPACT of regional energy trade integration on carbon emissions and energy access. *Energy Policy* **2020**, *147*, 111427. [CrossRef]
9. Gheorghe, L.; Ciupageanu, D.; Vătuiu, T. Highlights of renewable energy integration impact: Evolution and perspectives in Romania. In Proceedings of the 2020 21st International Symposium on Electrical Apparatus & Technologies (SIELA), Bourgas, Bulgaria, 3–6 June 2020; pp. 1–4.
10. Du, M.; Zhang, X.; Xia, L.; Cao, L.; Zhang, Z.; Zhang, L.; Zheng, H.; Cai, B. The China Carbon Watch (CCW) system: A rapid accounting of household carbon emissions in China at the provincial level. *Renew. Sustain. Energy Rev.* **2022**, *155*, 111825. [CrossRef]
11. Rigo, P.D.; Siluk, J.C.M.; Lacerda, D.P.; Rosa, C.B.; Rediske, G. Is the success of small-scale photovoltaic solar energy generation achievable in Brazil? *J. Clean Prod.* **2019**, *240*, 118243. [CrossRef]
12. Mundaca, L.; Samahita, M. What drives home solar PV uptake? Subsidies, peer effects and visibility in Sweden. *Energy Res. Soc. Sci.* **2020**, *60*, 101319. [CrossRef]
13. Radomes, A.A.; Arango, S. Renewable energy technology diffusion: An analysis of photovoltaic-system support schemes in Medellín, Colombia. *J. Clean Prod.* **2015**, *92*, 152–161. [CrossRef]
14. Guta, D.D. Determinants of household adoption of solar energy technology in rural Ethiopia. *J. Clean Prod.* **2018**, *204*, 193–204. [CrossRef]
15. Lu, Q.; Yu, H.; Zhao, K.L.; Leng, Y.J.; Hou, J.C.; Xie, P.J. Residential demand response considering distributed PV consumption: A model based on China's PV policy. *Energy* **2019**, *172*, 443–456. [CrossRef]
16. Shigetomi, Y.; Matsumoto, K.; Ogawa, Y.; Shiraki, H.; Yamamoto, Y.; Ochi, Y.; Ehara, T. Driving forces underlying sub-national carbon dioxide emissions within the household sector and implications for the Paris Agreement targets in Japan. *Appl. Energy* **2018**, *228*, 2321–2332. [CrossRef]

17. Karjalainen, S.; Ahvenniemi, H. Pleasure is the profit—The adoption of solar PV systems by households in Finland. *Renew. Energy* **2019**, *133*, 44–52. [CrossRef]
18. Sioshansi, R. Retail electricity tariff and mechanism design to incentivize distributed renewable generation. *Energy Policy* **2016**, *95*, 498–508. [CrossRef]
19. Zhang, S.F. Analysis of DSPV (distributed solar PV) power policy in China. *Energy* **2016**, *98*, 92–100. [CrossRef]
20. Park, C.K.; Kim, H.J.; Kim, Y.S. A study of factors enhancing smart grid consumer engagement. *Energy Policy* **2014**, *72*, 211–218. [CrossRef]
21. Ahmad, S.; Mat Tahar, R.B.; Cheng, J.K.; Yao, L. Public acceptance of residential solar photovoltaic technology in Malaysia. *PSU Res. Rev.* **2017**, *1*, 242–254. [CrossRef]
22. Drumond, P., Jr.; de Castro, R.D.; Seabra, J.A.E. Impact of tax and tariff incentives on the economic viability of residential photovoltaic systems connected to energy distribution network in Brazil. *Sol. Energy* **2021**, *224*, 462–471. [CrossRef]
23. Wang, B.; Wang, Q.; Wei, Y.M.; Li, Z.P. Role of renewable energy in China's energy security and climate change mitigation: An index decomposition analysis. *Renew. Sustain. Energy Rev.* **2018**, *90*, 187–194. [CrossRef]
24. Administration, N.E. Notification of the Comprehensive Department of the National Energy Administration on Publishing the Pilot List of Roof Distributed Photovoltaic Development in the WHOLE County (City, District). Available online: http://zfxxgk.nea.gov.cn/2021-09/08/c_1310186582.htm (accessed on 9 May 2022).
25. Martinez-Poveda, A.; Molla-Bauza, M.B.; Del Campo Gomis, F.J.; Martinez, L.M. Consumer-perceived risk model for the introduction of genetically modified food in Spain. *Food Policy* **2009**, *34*, 519–528. [CrossRef]
26. Kim, H.; Park, E.; Kwon, S.J.; Ohm, J.Y.; Chang, H.J. An integrated adoption model of solar energy technologies in South Korea. *Renew. Energy* **2014**, *66*, 523–531. [CrossRef]
27. Thakur, J.; Chakraborty, B. Impact of compensation mechanisms for PV generation on residential consumers and shared net metering model for developing nations: A case study of India. *J. Clean Prod.* **2019**, *218*, 696–707. [CrossRef]
28. De Groote, O.; Pepermans, G.; Verboven, F. Heterogeneity in the adoption of photovoltaic systems in Flanders. *Energy Econ.* **2016**, *59*, 45–57. [CrossRef]
29. Rinaldi, A.; Soini, M.C.; Patel, M.K.; Parra, D. Optimised allocation of PV and storage capacity among different consumer types and urban settings: A prospective analysis for Switzerland. *J. Clean Prod.* **2020**, *259*, 120762. [CrossRef]
30. Rajabi, A.; Elphick, S.; David, J.; Pors, A.; Robinson, D. Innovative approaches for assessing and enhancing the hosting capacity of PV-rich distribution networks: An Australian perspective. *Renew. Sustain. Energy Rev.* **2022**, *161*, 112365. [CrossRef]
31. Çağdaş, V.; Paasch, J.M.; Paulsson, J.; Ploeger, H.; Kara, A. Co-ownership shares in condominium—A comparative analysis for selected civil law jurisdictions. *Land Use Policy* **2020**, *95*, 104668. [CrossRef]
32. NBSC National Bureau of Statistics of China. China. Available online: http://data.stats.gov.cn/ (accessed on 1 May 2022).
33. The State Council The People's Republic Of China. Notification of the National Development and Reform Commission on Matters Related to the New Energy on Grid Tariff Policy in 2021. Available online: http://www.gov.cn/zhengce/zhengceku/2021-06/11/content_5617297.htm (accessed on 9 May 2022).
34. Luo, G.; Long, C.; Wei, X.; Tang, W. Financing risks involved in distributed PV power generation in China and analysis of countermeasures. *Renew. Sustain. Energy Rev.* **2016**, *63*, 93–101. [CrossRef]
35. Wüstenhagen, R.; Bilharz, M. Green energy market development in Germany: Effective public policy and emerging customer demand. *Energy Policy* **2006**, *34*, 1681–1696. [CrossRef]
36. Zhang, W.; Zhao, Y.; Huang, F.; Zhong, Y.; Zhou, J. Forecasting the Energy and Economic Benefits of Photovoltaic Technology in China's Rural Areas. *Sustainability* **2021**, *13*, 8408. [CrossRef]
37. Abreu, J.; Wingartz, N.; Hardy, N. New trends in solar: A comparative study assessing the attitudes towards the adoption of rooftop PV. *Energy Policy* **2019**, *128*, 347–363. [CrossRef]
38. Parkins, J.R.; Rollins, C.; Anders, S.; Comeau, L. Predicting intention to adopt solar technology in Canada: The role of knowledge, public engagement, and visibility. *Energy Policy* **2018**, *114*, 114–122. [CrossRef]
39. Mola, L.; Berger, Q.; Haavisto, K.; Soscia, I. Mobility as a Service: An Exploratory Study of Consumer Mobility Behaviour. *Sustainability* **2020**, *12*, 8210. [CrossRef]
40. Zhang, J.; Ma, L.; Li, J. Why Low-Carbon Publicity Effect Limits? The Role of Heterogeneous Intention in Reducing Household Energy Consumption. *Energies* **2021**, *14*, 7634. [CrossRef]
41. Fu, W.; Zhou, Y.; Li, L.; Yang, R. Understanding household electricity-saving behavior: Exploring the effects of perception and cognition factors. *Sustain. Prod. Consum.* **2021**, *28*, 116–128. [CrossRef]
42. Teng, Y.H.; Liu, C.J.; Chen, Y.; Lai, L.Y. Decision research on rural residents' clean energy applied behavior based on a SEM model. *China Popul. Resour. Environ.* **2017**, *27*, 186–195. (In Chinese)
43. Xie, B.X. Discussion on Golden Sun pilot project investment profit. *Renew. Energy Resour.* **2011**, *6*, 160–161.
44. National Development and Reform Commission China's Photovoltaic Industry Development Roadmap 2021. Available online: http://www.chinapv.org.cn/road_map/1016.html (accessed on 9 May 2022).
45. He, Y.; Pang, Y.; Li, X.; Zhang, M. Dynamic subsidy model of photovoltaic distributed generation in China. *Renew. Energy* **2018**, *118*, 555–564. [CrossRef]
46. Liu, Z.M.; Li, X.; Peng, X.R.; Lee, S. Green or nongreen innovation? Different strategic preferences among subsidized enterprises with different ownership types. *J. Clean Prod.* **2019**, *245*, 118786. [CrossRef]

47. Steg, L. Promoting household energy conservation. *Energy Policy* **2008**, *36*, 4449–4453. [CrossRef]
48. Muhammad-Sukki, F.; Ramirez-Iniguez, R.; Abu-Bakar, S.H.; McMeekin, S.G.; Stewart, B.G. An evaluation of the installation of solar photovoltaic in residential houses in Malaysia: Past, present, and future. *Energy Policy* **2011**, *39*, 7975–7987. [CrossRef]
49. Ert, E.; Lejarraga, T. The Effect of Experience on Context-dependent Decisions. *J. Behav. Decis. Mak.* **2018**, *31*, 535–546. [CrossRef]
50. Cai, Z.; Liu, Q.; Cao, S. Real estate supports rapid development of China's urbanization. *Land Use Policy* **2020**, *95*, 104582. [CrossRef]
51. Wang, B.; Ke, R.; Yuan, X.; Wei, Y. Chinaports rapid development of China's urbergy vulnerability to climate change. *Renew. Sustain. Energy Rev.* **2014**, *40*, 185–195. [CrossRef]
52. Wang, S.; Li, Y.; Jia, J. How to promote sustainable adoption of residential distributed photovoltaic generation in China? An employment of incentive and punitive policies. *Mitig. Adapt. Strat. Glob. Chang.* **2022**, *27*, 16. [CrossRef]
53. Dos Santos, L.L.C.; Canha, L.N.; Bernardon, D.P. Projection of the diffusion of photovoltaic systems in residential low voltage consumers. *Renew. Energy* **2018**, *116*, 384–401. [CrossRef]
54. Nationl Development and Reform Commission Opinions of the National Development and Reform Commission and the National Energy Administration on Improving the Institutional Mechanisms and Policies and Measures for Green and Low-Carbon Energy Transformation. Available online: https://www.ndrc.gov.cn/xxgk/zcfb/tz/202202/t20220210_1314511.html?code=&state=123 (accessed on 9 May 2022).
55. Guagnano, G.A.; Stern, P.C.; Dietz, T. Influences on Attitude-Behavior Relationships. *Environ. Behav.* **1995**, *27*, 699–718. [CrossRef]
56. Gonçalves, J.E.; Montazeri, H.; van Hooff, T.; Saelens, D. Performance of building integrated photovoltaic facades: Impact of exterior convective heat transfer. *Appl. Energy* **2021**, *287*, 116538. [CrossRef]
57. Alghamdi, A.S. Performance Enhancement of Roof-Mounted Photovoltaic System: Artificial Neural Network Optimization of Ground Coverage Ratio. *Energies* **2021**, *14*, 1537. [CrossRef]
58. Sechilariu, M.; Wang, B.; Locment, F. Building Integrated Photovoltaic System with Energy Storage and Smart Grid Communication. *IEEE Trans. Ind. Electron.* **2013**, *60*, 1607–1618. [CrossRef]
59. Yang, Y.; Campana, P.E.; Stridh, B.; Yan, J. Potential analysis of roof-mounted solar photovoltaics in Sweden. *Appl. Energy* **2020**, *279*, 115786. [CrossRef]
60. Hartvigsson, E.; Odenberger, M.; Chen, P.; Nyholm, E. Estimating national and local low-voltage grid capacity for residential solar photovoltaic in Sweden, UK and Germany. *Renew. Energy* **2021**, *171*, 915–926. [CrossRef]
61. Davis, F.D. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Q.* **1989**, *13*, 319–340. [CrossRef]
62. Chen, Y.; Chi, T. How Does Channel Integration Affect Consumers' Selection of Omni-Channel Shopping Methods? An Empirical Study of U.S. Consumers. *Sustainability* **2021**, *13*, 8983.
63. Passafaro, P. Attitudes and Tourists' Sustainable Behavior: An Overview of the Literature and Discussion of Some Theoretical and Methodological Issues. *J. Travel. Res.* **2020**, *59*, 579–601. [CrossRef]
64. Xu, X.; Maki, A.; Chen, C.; Dong, B.; Day, J.K. Investigating willingness to save energy and communication about energy use in the American workplace with the attitude-behavior-context model. *Energy Res. Soc. Sci.* **2017**, *32*, 13–22. [CrossRef]
65. Tingchi Liu, M.; Brock, J.L.; Cheng Shi, G.; Chu, R.; Tseng, T.H. Perceived benefits, perceived risk, and trust. *Asia Pac. J. Mark. Logist.* **2013**, *25*, 225–248. [CrossRef]
66. Phang, C.W.; Sutanto, J.; Kankanhalli, A.; Li, Y.; Tan, B.C.Y.; Teo, H.H. Senior Citizens' Acceptance of Information Systems: A Study in the Context of e-Government Services. *IEEE Trans. Eng. Manag.* **2006**, *53*, 555–569. [CrossRef]
67. Stern, P.C. New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior. *J. Soc. Issues* **2010**, *56*, 407–424. [CrossRef]
68. Hair, J.F. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*; SAGE: Los Angeles, CA, USA, 2017.
69. China Photovoltaic Industry Association. Household Photovoltaic Project Information. Available online: http://www.chinapv.org.cn/data_statistics/970.html (accessed on 9 May 2022).
70. Wynne, C.W. Issues and Opinion on Structural Equation Modeling. *Mis Q.* **1998**, *22*, 7–16.
71. Hair, J.F.; Sarstedt, M.; Ringle, C.M.; Mena, J.A. An Assessment of the Use of Partial Least Squares Structural Equation Modeling in Marketing Research. *J. Acad. Mark. Sci.* **2012**, *40*, 414–433. [CrossRef]
72. Henseler, J.; Ringle, C.M.; Sarstedt, M. Testing measurement invariance of composites using partial least squares. *Int. Mark. Rev.* **2016**, *33*, 405–431. [CrossRef]
73. Hair, J.; Sarstedt, M.; Ringle, C.; Gudergan, S. Advanced Issues in Partial Least Squares Structural Equation Modeling. Sage Publications, Inc.: Thousand Oaks, CA, USA, 2017; pp. 112–114.
74. Thongrattana, P. *Assessing Reliability and Validity of a Measurement Instrument for Studying Uncertain Factors in Thai Rice Supply Chain*; HDR Student Conference; University of Wollongong: Wollongong, Australia, 2010; p. 2022.
75. Hu, L.T.; Be Ntler, P.M. Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychol. Methods* **1998**, *3*, 424–453. [CrossRef]
76. Wei, Q.; Shi, H.; Ma, X.; Shi, Y.; Zhang, Y.; Wang, L. The impact of maternal stress on offspring birth weight and the mediating effect of dietary patterns: The Shanghai Maternal-Child Pairs Cohort study—ScienceDirect. *J. Affect. Disord.* **2021**, *278*, 643–649. [CrossRef]

77. Hess, T.J.; McNab, A.L.; Basoglu, K.A. Asli Reliability Generalization of Perceived Ease of Use, Perceived Usefulness, and Behavioral Intentions. *Mis Q.* **2014**, *38*, 1–28. [CrossRef]
78. Wang, R.; Feng, Z.; Pearce, J.; Liu, Y.; Dong, G. Are greenspace quantity and quality associated with mental health through different mechanisms in Guangzhou, China: A comparison study using street view data. *Environ. Pollut.* **2021**, *290*, 117976. [CrossRef]
79. Council, Office of the Leading Group of the State Council for the Seventh National Population Census. China Population Census Year Book 2020. Available online: http://www.stats.gov.cn/tjsj/pcsj/rkpc/7rp/indexch.htm (accessed on 1 July 2022).
80. Topolšek, D.; Babić, D.; Babić, D.; CvahteOjsteršek, T. Factors Influencing the Purchase Intention of Autonomous Cars. *Sustainability* **2020**, *12*, 10303. [CrossRef]