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Modeling public acceptance of renewable energy deployment: a pathway towards green revolution

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ABSTRACT

Renewable energy adoption is a complicated process that is influenced by a multitude of different factors. Previous studies seldom examine the social acceptance of renewable energy from the Chinese perspective in Shandong province. To bridge this gap, comprehensive research is crucial to find the public attitude towards renewable energy. We extended the theory of planned behavior by incorporating three additional factors, i.e., risk perception, environmental concern, and belief about renewable energy costs. A questionnaire survey was conducted in the four major cities of Shandong province. The Logit model was used to determine possible factors affecting public acceptance. Research findings reveal that residents significantly support renewable energy regarding its positive environmental impact. Individuals' education, personal income, awareness and belief of renewable energy consumption cost positively affect their intention to utilize renewable energy, as the willingness to pay increases with an increase in these factors while decreasing with individuals' age. Young people with higher education and income are willing to pay extra for green energy. Research results emphasized the importance of enhancing public awareness and highlighting renewable energy benefits to win public acceptance of renewable energy deployment.

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1. Introduction

Renewable energy has emerged as a promising way to solve energy problems and improve the living condition of residents (Upreti & van der Horst, 2004). Globally, policymakers have prioritized the development of renewable energy technologies. The move from traditional methods of generating power to renewable sources results from regulatory bodies and civil society's desire for green production and usage

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(Irfan et al., 2022). Due to population growth and economic growth, the demand for energy has reached its peak, prompting governments to consider alternative energy production methods and mitigate greenhouse emissions by relying very little on fossil fuels (Cherni et al., 2007).

Therefore, various nations have undertaken numerous endeavors to effectively consume energy resources and increase the proportion of renewable energy technologies in national energy portfolios (Niu et al., 2013; Irfan et al., 2019a, 2019b, 2019c). Renewable energy has been recognized as an adequate substitute for conventional sources of power (Schmidt et al., 2016). It is considered that renewable energy initiatives enhance the quality of human existence in several ways. *First,* these sources can improve people's health by reducing carbon emissions and environmental damage caused by thermal power stations. *Second,* the reliance on renewable energy develops various employment for residents, immediately bolstering the country's economy. *Third,* it offers inexpensive power and will moderate future electricity costs (Kaygusuz, 2012; Caspary, 2009; Iniyan et al., 2000).

Although renewable energy is believed to be capable of satisfying the electricity requirements of a rapidly expanding population sustainably, and policymakers have a positive attitude toward its development, there are also issues, as some renewable energy projects have encountered solid public opposition worldwide (Kaldellis, 2005). By understanding how residents feel about renewable energy, authorities will accelerate the development of renewable energy, reducing carbon emissions and improving residents' living conditions. Previous studies examined the public's perspective on renewable energy in most developed nations. According to surveys, some renewable energy technologies have moderate to significant public acceptance (Krohn & Damborg, 1999; Wolsink, 2000). Bidwell (2013) analyzed the perspective of customers on wind power. Inhabitants hold a favorable view of wind energy and believe wind farms provide economic benefits to the local community, according to the findings of a study. In a different study by Rogers et al. (2008), it was revealed that there is widespread public support for renewable energy, as residents expect benefits from renewable energy projects in terms of the conservation of natural resources and increased community spirit. Similar public attitudes were observed by Musall and Kuik (2011), Devine-Wright (2005), and Liu et al. (2013).

On the contrary, there also exist cases in which some renewable energy projects become failed due to strong public opposition (Burke & Stephens, 2018; Wüstenhagen et al., 2007). For instance, renewable energy programs faced negative public attitudes in Europe (Walker, 1995), while biomass development projects faced significant public disapproval in the United Kingdom. Similarly, wind energy confronted strong resistance in Germany and Greek. Karlstrøm and Ryghaug (2014) scrutinized the Public attitudes towards renewable energy technologies in Norway. They found that sometimes people are unwilling to support renewable energy technologies. Eltham et al. (2008) found that people negatively perceive wind farms in the United Kingdom. Research on renewable energy's public acceptance varies from small-scale, stand-alone developments to large-scale, grid-connected projects. Public attitude towards renewable energy and the factors affecting its development have been examined by many researchers (Jobert et al., 2007).

The reasons for public opposition to these projects are numerous. For example, noise and visual effects often criticize wind power projects. Moreover, the potential threat to birds and wildlife is another prominent reason for the low public acceptance of wind farms (D'Souza & Yiridoe, 2014). Some hydropower projects have been opposed by the public, as the area's biodiversity was affected during a flood. Some small-scale projects also have been rejected by the local community due to their interference with rivers (Valencia, 2009; Schilling & Esmundo, 2009). Similarly, the stability of land is affected by geothermal energy, which may cause earthquakes (Rybach, 2003). Biomass energy is inappropriate due to the emissions produced during the regular operation of biomass power plants (Singh & Gu, 2010) and in some cases, solar energy has been overlooked due to unawareness of its affordability.

Several studies (Molnarova et al., 2012; Sauter & Watson, 2007) have focused on the institutional capacity underlying the social acceptance of renewable energy, as regulations, effective policies, support mechanisms, and economic incentives were essential elements. Some studies have highlighted the behavior from a psychological standpoint at the individual level (Huijts et al., 2012), and these investigations have utilized environmental activism and quantitative evaluations (Bang et al., 2000; Tanner & Wölfing Kast, 2003; Hansla et al., 2008) to a large extent. Some individuals believe that policies do not appear to be transforming, but they want to see progress. Thus, they engaged in a practice known as environmental activism. Willingness to pay (WTP) for renewable energy was estimated considering inhabitants' attitudes (Nomura & Akai, 2004). It suggests that inhabitants' mindset impacts the amount of readiness to spend additional investments for renewable energy. Moreover, various researchers studied the variables and aspects which impact public acceptability. Similarly, Hansla et al. (2008) demonstrate that WTP for renewable energy increase with an optimistic view, that it helps to alleviate ecological issues and lessen the prices of electricity. Such findings were quite similar to Bang et al. (2000). Likewise, wealth, size of family (Zografakis et al., 2010), education, age (Ek, 2005), personal experience (Batley et al., 2000) and social standing (Batley et al., 2001) are all key determining variables.

In general, research studies have been conducted in nations with clear governmental objectives to reduce carbon emissions. Several studies have mainly explored the disparity between social acceptance and governmental targets for boosting the share of renewable energy in the entire energy mix. They said that societal acceptability hinders the spread of renewable energy and prevents the attainment of national objectives (Wüstenhagen et al., 2007). This demonstrates the importance of societal acceptability in developing renewable energy sources. In China, little study has been conducted to determine the public acceptance of renewable energy. For example, Talpur et al. (2017) analysed the perceptions of homeowners in Sindh province on the acceptability of solar energy. Solar energy is well-known and widely accepted, according to the conclusions of this study.

Besides this, no other study has examined the public acceptance of renewable energy technologies in Shandong province of China. Compared to ambitious national objectives, renewable energy adoption in China remains in its infancy. To fulfil this research gap, there is an urgent need to conduct comprehensive research to

determine the country's public attitude towards renewable energy. We intend to focus on the general character of renewable energy technologies in this study, as it has a positive environmental impact. Moreover, significant factors which affect public acceptance of renewable energy were determined by employing a Logit model. In addition, we extended the theory of planned behavior by introducing three new factors, i.e., environmental concern, risk perception, and belief about renewable energy costs, which is an additional contribution of this study.

The paper has organized as follows: Section 2 elaborates on the theoretical framework and research methods. Data analysis and results are presented in Section 3. Discussion and policy implications are provided in Section 4. Finally, Section 5 concludes the study along with study limitations.

2. Research methodology

2.1. Theoretical framework

The purchasing decision of consumers is a complicated method. Numerous studies have examined the public's acceptance of renewable energy from multiple perspectives, such as self-efficacy theory, social cognitive theory, and the theory of reasoned action. In contrast to contextual research findings, this research focuses on individual behaviour. To evaluate public acceptance, the variable 'behavioural willingness' was chosen. The notion of reasoned action and planned behaviour was employed to construct a theoretical model. In 1967, Ajzen and Fishbein created the notion of reasoned action (Fishbein & Ajzen, 1977).

This theory explains that an individual's behaviour is determined by behavioural intention. Individuals consider its repercussions when engaging in a given activity and then engage in an action that leads to the desired outcome. Two components comprise behavioural intention. These are subjective norms and attitude standards towards behavior. Subjective norms consist of the complete sum of views about a commodity held by influential people and organizations who believe that a person should conform to this conduct (Bang et al., 2000). Although "an individual's sense of approval or disapproval towards a conduct" is referred to as an attitude towards the action (Irfan et al., 2020, ESPR). People's attitudes comprise their resonant beliefs and estimated outcomes for a particular activity.

Ajzen later proposed the theory of planned behavior in 1985, as he noticed that behavior is always under some control and not voluntary. At the same time, the theory of reasoned action considers that behavior is voluntary and formed by subjective norms and individual attitudes (Irfan et al., 2021). As a result, he added the concept of perceived behavioral control. It is described as a person's estimation of how simple or difficult it is to execute the behavior of concern (Ajzen, 2002). This is how perceived facilitation and control beliefs operate (Figure 1). Control belief evaluates the availability or lack of essential opportunities and resources needed to conduct a behavior. While the evaluation of the importance of these resources to get desired results is termed perceived facilitation (Ajzen & Madden, 1986).

The theory of planned behavior effectively explains and predicts an individual's behavior and has been extensively utilized in various contexts (Chang, 1998).

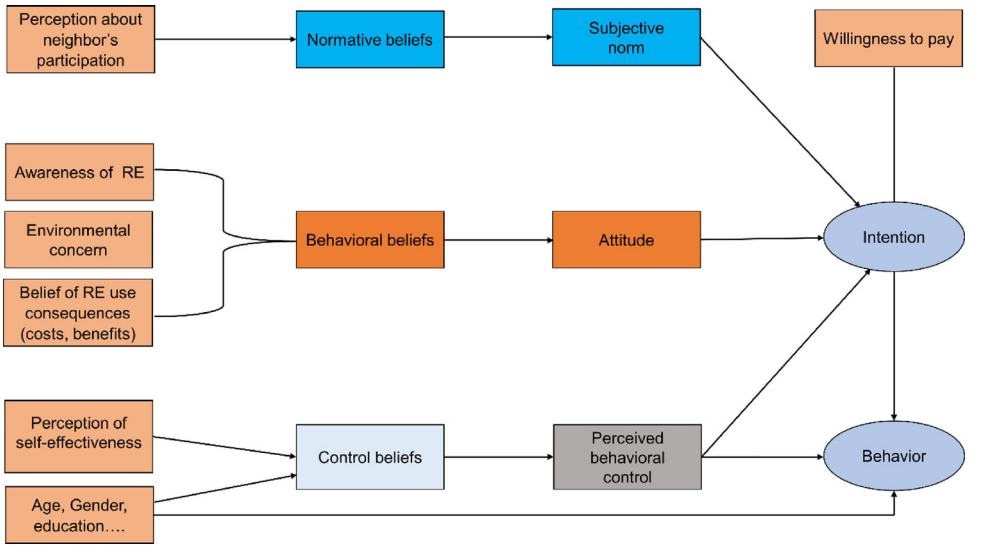

Figure 1. Extended theory of planned behavior research framework.
Source: (Liu et al., 2013).

Numerous scholars have adapted this approach to numerous consumer areas of research. For example, organizational, e-commerce, environmentally friendly conduct, and the recognition that this theory applies to examining consumer behavior. Scholars concur that various economic, social, and regulatory variables impact the acceptance of any given technology. We evaluated the general public's attitude regarding renewable energy based on their desire to increase their WTP for green power. Figure 1 depicts the research's analytical model. Relationship between different variables has been examined to realize the factors affecting inhabitants' behavioral intentions. We extended the theory of planned behavior by including three new variables, i.e., environmental concern, risk perception, and belief about renewable energy costs. Combined with existing variables (awareness about renewable energy, beliefs about the positive consequences of renewable energy and subjective norms), we measured these significant variables related to attitude toward behavior. Control variables, including gender, education, income, and age, were also incorporated, defining the respondents' demographic characteristics and revealing perceived behavioral control (Figure 1).

2.2. Questionnaire development and assessment of variables

The questionnaire was developed based on the analytical framework (Figure 1). The questionnaire has been divided into three sections. In the first section, questions about socioeconomic characteristics, such as gender, age, education, personal income, and occupation, were asked. The questions covered in the second section were mainly about awareness of renewable energy, environmental concern, beliefs about the benefits and costs of using renewable energy, risk perception, perception of neighbors' participation, perception of self-effectiveness and the attitude towards renewable energy. More specifically, we tested the respondent's awareness of renewable energy.

If the respondent knows renewable energy, they will get a score 'of 1′, and if the respondent doesn't know, they will get a '0' score. Environmental concern-related questions were adapted from the studies of (Hartmann & Apaolaza-Ibáñez, 2012). Several questions were asked to measure residents' beliefs about the advantages and costs of renewable energy utilization (Alam et al., 2014). Answers were measured on a 5-point Likert scale, with 1 being strongly disagreed to 5 strongly agree. An aggregated result of all scale items is then considered as the projected value of these. To make each variable comparable, first, we standardized all variables and then ran the logit model.

Precise and directed questions were asked to evaluate other variables. To assess 'risk perception,' different questions, including *paying for green energy is not a risky option?* were asked. Similarly, to assess 'the perception about neighbors' participation,' we asked, *whether neighbors' participation in using renewable energy influence you to buy renewable energy products?*. To measure another variable, 'perception of self-effectiveness, the question *do you think that the community will appreciate your action of buying green energy?* was asked. Respondents' willingness to pay was asked, *if your monthly electricity bill is Chinese rupees (PKR) 1000, and to obtain all electricity from green sources, what amount of extra money are you willing to pay?*. Several choices, i.e., 10–20%, 21–30%, 31–40% were given. Moreover, control variables, including gender, occupation, age, personal income, and education, were also examined in the questionnaire. The third section was designed to know the factors which can hinder or motivate to buy renewable energy (see Appendix A).

2.3. Research area and data collection

A questionnaire survey was conducted in the four major cities of Shandong province during May and June 2022. Shandong is the fastest emerging regions in China, having a share of 54% of the country's total economy. Inhabited by 110 million people, Shandong is an agricultural province. The province dominates the agriculture sector with more than 62% and ranks first in the country (Pasha, 2015). With a constantly growing population and expanding economy, the deficiency of energy has evolved into the greatest obstacle to environmental sustainability. In terms of economic structure, the province demonstrates the distinctive characteristics of China. Tremendous renewable energy potential exists in this province. Consequently, various projects have been started here to utilize abundant renewable sources. Various wind energy and biogas projects have also been completed in the province. Besides, several new renewable energy projects are under construction and will play a critical role in the energy transition from conventional to renewable energy.

We chose participants in each city by employing a random sampling method. For responders to provide accurate responses, every part of the survey questionnaire was thoroughly explained. There was a total of 380 valid replies gathered. Table 1 lists the demographic characteristics of respondents. Male residents were 58% and females 42%. The largest respondents were young people (33%) aged between 26 and 35. 38% were college graduates. Hence, participants were literate and young. 125 respondents

Table 1. Demographic characteristics of respondents.

Characteristics	Possible responses	n	Percentage (%)
Age	18-25	45	11.8
	26-35	125	32.9
	36-45	90	23.7
	46-60	76	20
	More than 60	44	11.6
Gender			
	Male	221	58.2
	Female	159	41.8
Income			
	Less than 5,000	16	4.2
	5,001–8,000	24	6.3
	8,001–10,000	103	27.1
	10,001–12,000	124	32.6
	12,001–15,000	93	24.5
	More than 15,000	20	5.3
Education			
	Illiterate	15	3.9
	Primary	67	17.6
	middle	86	22.6
	College degree	143	37.6
	Graduate	69	18.2
Occupation			
	Technical personnel	134	35.3
	Government Job	101	26.6
	Own Business	66	17.4
	Farmer	46	12.1
	Other	33	8.7

Source: survey data.

(32.6%) have CNY 10,001-12,000 income monthly. In our survey, more than 35% of the respondents belong to the technical occupation.

3. Data analysis and results

3.1. Awareness and attitude of respondents

In the second section of the questionnaire, we examined respondents' awareness of renewable energy by asking the question, *whether the respondent has heard about renewable energy before?*. And as expected, most (96%) of the individuals answered yes. To examine respondents' environmental concerns, we asked, *are you worried about environmental problems?*. 90% showed concern regarding environmental problems. We further asked that *according to your opinion, air pollution and shortage of water are the biggest environmental problems.* Results revealed that 90% of the respondents agreed with this statement. 6% of the respondents neither agreed nor disagreed. At the same time, 4% of the individuals don't think these are the most significant environmental problems (Figure 2).

Users' beliefs about the benefits associated with using renewable energy were evaluated by asking, *do you think that the utilization of renewable energy reduces carbon emissions and improves energy structure?*. The results revealed that 87% of the respondents have a high degree of positive beliefs regarding the use of renewable energy and scored over 3 (Figure 3). This suggests that respondents are familiar with adopting renewable energy's positive outcomes.

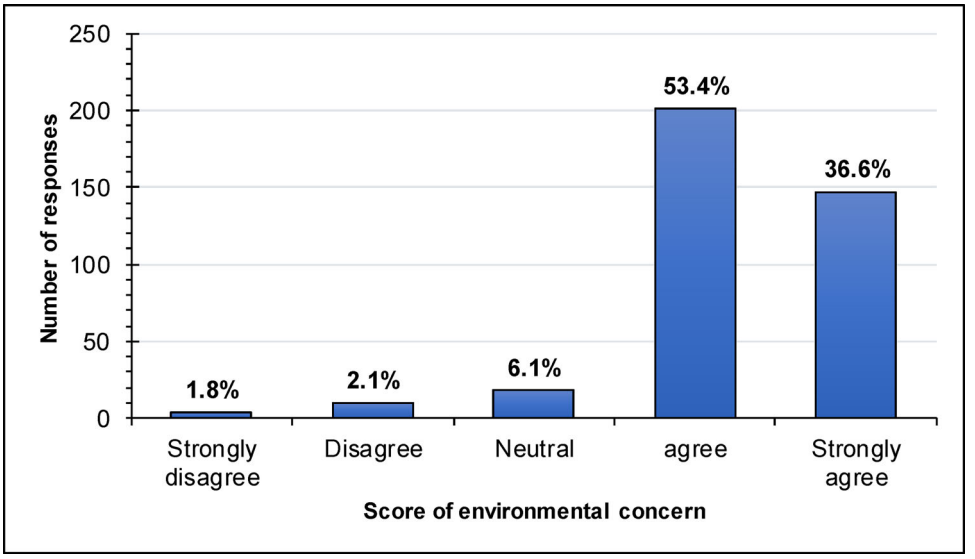

Figure 2. Valuation of concern for the environment.
Source: Authors' calculations.

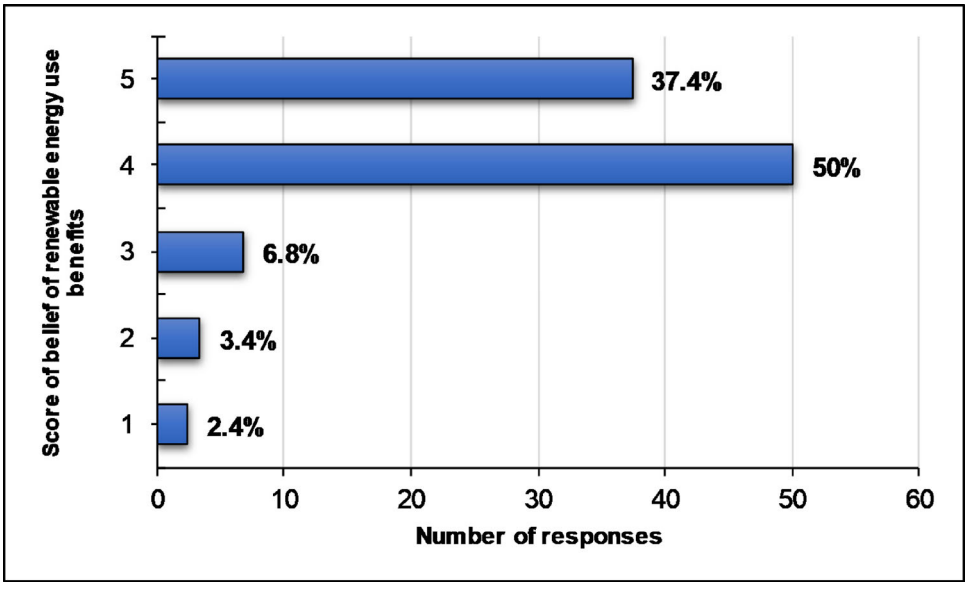

Figure 3. Assessment of belief of benefits of renewable energy use.
Source: Authors' calculations.

Similarly, we asked *whether renewable energy consumption produces extra costs?* to measure householders' beliefs about the costs of renewable energy utilization. 32% of them revealed that they didn't have any idea about it and answered neutrally. 54% believe that renewable energy projects lead to an increase in cost. In contrast, 14% believe utilizing renewable energy would not increase the extra cost (Figure 4).

The next question was, *how do you get information about renewable energy?*. Over 61% of the respondents answered that they get information from the news. 18% get

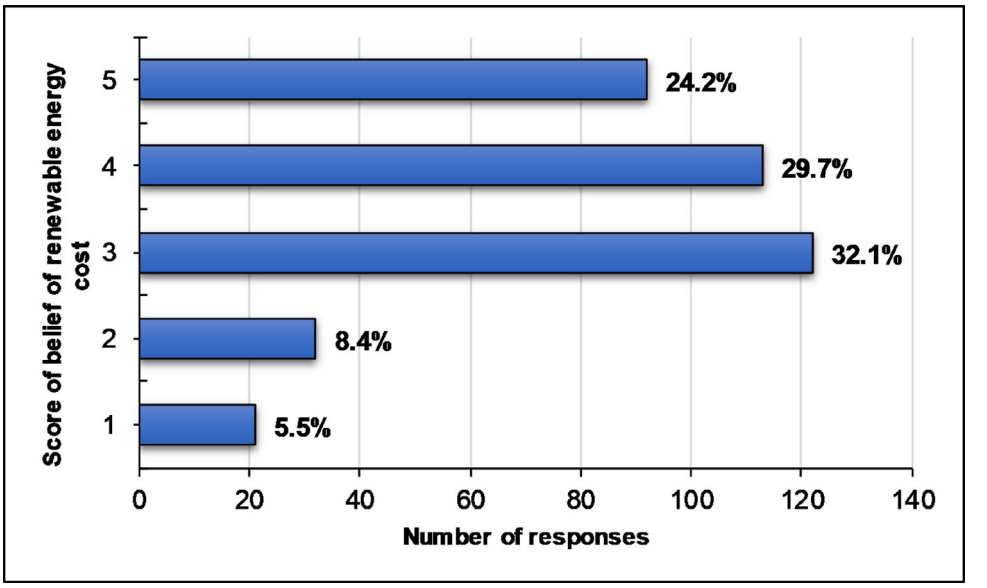

Figure 4. Assessment of belief of renewable energy costs.
Source: Authors' calculations.

informed through television. When respondents were asked about *what's your preferred renewable energy source?*. This question listed different types of renewable energy sources, i.e., solar, wind, biomass, hydro, and biofuels. Interestingly, 67% of the participants consider 'solar energy' the best renewable energy source. While 16% of the respondents selected 'biomass energy' as the second most important option. 12% of the respondents choose 'wind energy' as the third most important renewable energy source. These findings show that solar energy is the best and most easily accessible renewable energy technology in China. Consumers already have high awareness and acceptance of solar water heaters (Bhutto et al., 2012).

To examine the influence of subjective norms, we added 'the perception about neighbors' participation variable' in the questionnaire. The responses show that the participation of neighbors matters significantly. As 80% of the residents specified, if their neighbor decides to utilize any kind of renewable energy (solar, biomass), they will follow the same action. This shows that residents are influenced by neighbors' behavior of energy consumption patterns. Therefore, if a successful case happens, it would be elementary to diffuse renewable energy quickly. Similarly, the variable perception of self-effectiveness was included to find the impact of perceived behavioral control. 86% of the respondents reported that society would appreciate their action of consuming green energy, and other people would be influenced positively by their behavior.

Generally, residents exhibit great support for renewable energy utilization and the transition of energy from the conventional approach to an environment-friendly approach. Moreover, most respondents (70%) indicated WTP for green energy. At the same time, 30% of them are unwilling to pay. From the 70% of the respondents (willing to pay), 40% are willing to pay 0-10% extra money but can't accept pay more

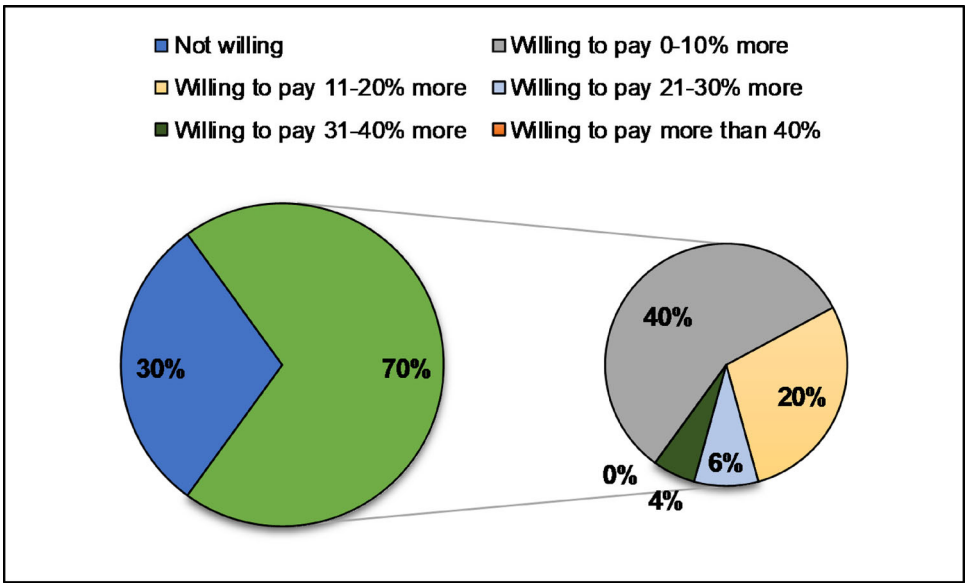

Figure 5. Willingness to pay for renewable energy.
Source: Authors' calculations.

than this level (Figure 5). Overall, WTP was relatively high, but it should be in an affordable range.

3.2. Influencing factors of willingness to pay

According to previous studies, income, education, and social norms positively influence the WTP for green energy (Roe et al., 2001; Zarnikau, 2003). We included new variables to explore "whether WTP is affected by respondents' environmental concern, the belief of renewable energy's extra costs and risk perception." The effect of other factors, i.e., individuals' awareness about renewable energy and belief in positive outcomes of renewable energy consumption, was also measured. We developed the following binomial logit model.

$$P(y = 1) = \exp(z)/(1 + \exp(z)) \tag{1}$$

$$Z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots\ldots + \beta_n x_n + \varepsilon_1 + \varepsilon_2 + \varepsilon_3 + \ldots\ldots + \varepsilon_n \tag{2}$$

$$Z = \beta_o + \sum_{i=1}^{n} \beta_i x_i + \varepsilon_i \tag{3}$$

Here, β represents the vector of parameters to be assessed, x_i represents the explanatory variables' vector of observations, while ε denotes the random error. The '0' value was assigned if the resident showed negative WTP for green energy, while if the resident declared positive WTP, the '1' value was assigned. We included all variables in the model and employed a backward stepwise selection method. Results show

Table 2. Logit regression model of consumers' WTP for renewable energy.

	Model A		Model B	
Explanatory variables	Coefficient[a]	Marginal effects	Coefficient	Marginal effects
C	1.320*	—	0.992***	—
Gender	0.283	0.033	0.310	0.036
Age	−0.311**	−0.036**	−0.328***	−0.038***
ARE	0.416*	0.048*	0.519***	0.060***
ED	0.539	0.063	0.552***	0.064***
BCRE	0.380**	0.044**	0.429***	0.050***
RP	−0.297	−0.035	−0.188	−0.028
PI	0.517**	0.060**	0.491***	0.057***
EC	0.175	0.020	0.153	0.018
OP	0.271	0.032	—	—
PNP	0.130	0.015	0.203	0.023
BBRE	0.118	0.014	0.238	0.027
Pseudo R^2	0.2109		0.2953	
F-statistic	9.33		13.84	

Notes: **C:** constant, **ARE:** Awareness of renewable energy, **ED:** education, **BCRE:** belief about costs of renewable energy utilization, **RP:** risk perception, **PI:** personal income, **EC:** environmental concern, **OP:** occupation, **PNP:** perception about neighbor's participation, **BBRE:** belief about benefits of renewable energy, **R^2:** R-square.
[a]***Significant at 1%; **Significant at 5%; *significant at 10%.
Source: Authors' calculations.

no significant effect of the 'perception of self-effectiveness' variable on the model; consequently, it was removed. To develop the model as good as possible, we further checked multi-collinearity among independent variables. The findings indicate that multi-collinearity is not a problem in our study, as the variance inflation factor (VIF) is less than 5 for all independent variables. By adopting the maximum likelihood function, coefficients were estimated. The research results have been summarized in Table 2.

The effects of 11 variables were analyzed in model A. Results show that WTP is significantly related to residents' level of education, awareness about RE, and belief in the extra costs of RE utilization. However, it was found that the variable 'occupation' was correlated with residents' education and personal income, affecting the significance level of other independent variables in model A. Considering this, we removed this variable and estimated model B, which produced better estimates with an improved significance level (Table 2). Research findings reveal that the effects of the five variables are significant. These are individuals' age, education, personal income, the belief of extra costs of RE utilization, and awareness of RE. The effect of independent variables can be understood by the sign of coefficients. For instance, the variable 'awareness about renewable energy' has a positive sign coefficient, which suggests that those with a good attitude toward renewable energy are more likely to embrace costly green power if they are acquainted with it.

Similarly, positivity towards the additional expenses related to renewable power usage improves the chance of WTP. Results also show a positive coefficient for this variable (Table 2). Residents know why they should pay extra money for green energy because they understand that renewable energy utilization leads to high costs.

The age variable has a negative coefficient, which means that older people are unwilling to pay extra for renewable energy. In comparison, younger people have a positive attitude toward paying extra money for it. Education and personal income also have a significant effect on the positive WTP, which means that residents with

higher education and income tend to pay more for green energy. Research results reveal that personal income is the primary determinant of WTP for household energy utilization. Marginal effects of all explanatory variables were also computed after this logit regression model. The results show that four variables have positive and significant marginal effects, and the probability of positive WTP is affected most by a change in the awareness variable (Table 2). However, the marginal effects and coefficients of other variables are statistically insignificant in this model.

3.3. Barriers to buying renewable energy

Respondents were also asked to identify the leading causes of not buying renewable energy. 40% of the respondents show that the high price of renewable energy is a significant barrier to not buying renewable energy. 35% revealed that lack of awareness is another critical barrier which hinders them from buying renewable energy. The third main barrier was the limited government subsidies (11%). 8% reported that social norms such as "perception about neighbor's participation" were significant barriers. 6% of the respondents said that some government policies regarding renewable energy are very confusing, restraining them from buying renewable energy (Figure 6). Yuan et al. (2011) revealed that the main reasons for not buying renewable energy were a lack of awareness and high capital cost. The study by Hast et al. (2015) showed that the critical barrier to buying green energy was the price. The results of these studies are in line with our findings, as high cost and lack of awareness have been identified as significant barriers.

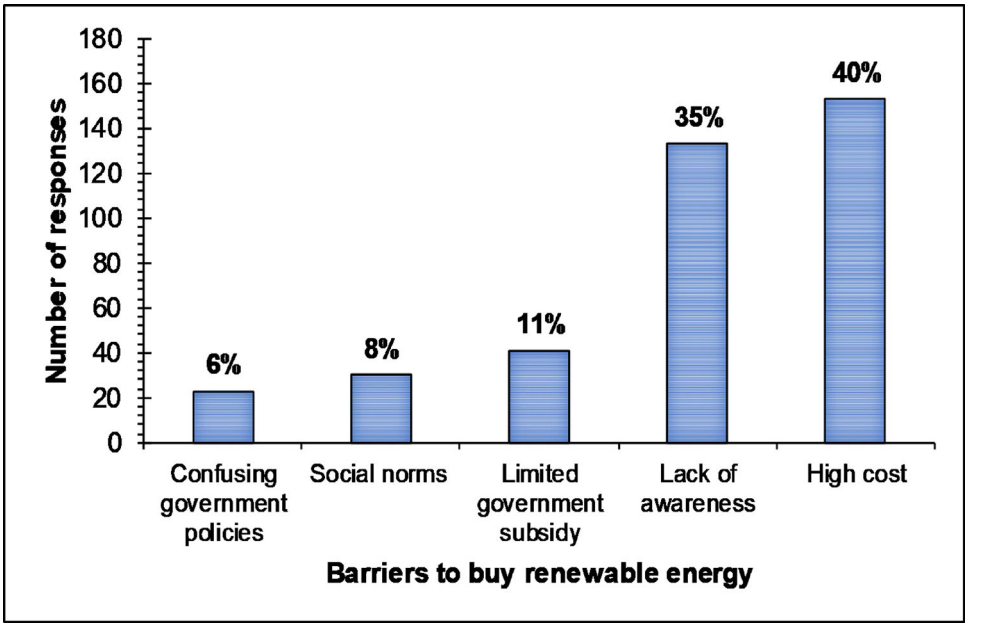

Figure 6. Barriers to buy renewable energy.
Source: Authors' calculations.

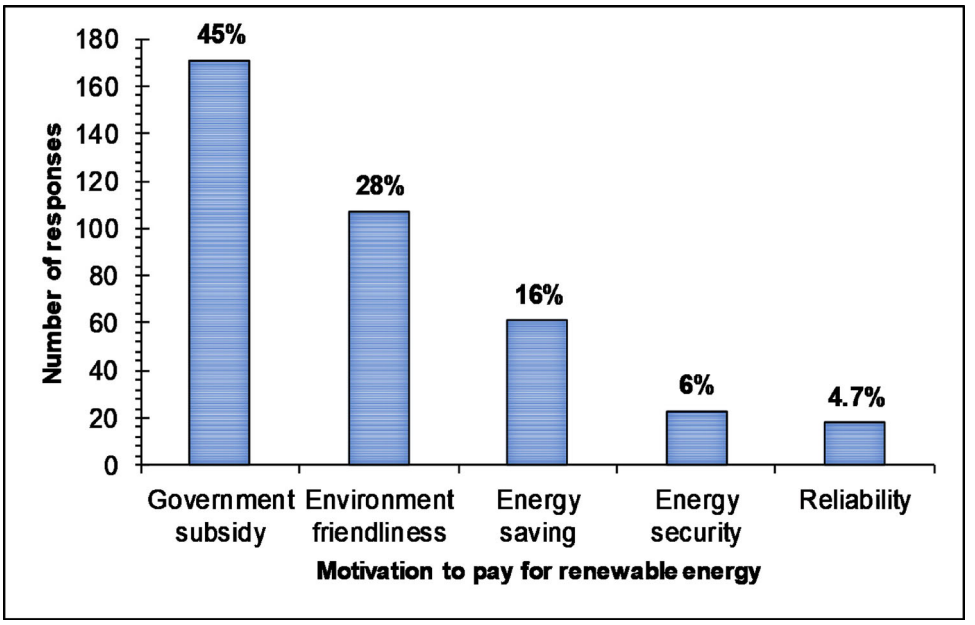

Figure 7. Motivation to pay for renewable energy.
Source: Authors' calculations.

3.4. Motivation to pay for renewable energy

Several options were provided to determine the main factors that could motivate respondents to pay for renewable energy. Most of the respondents (45%) answered that they would buy renewable energy if the government provided subsidies (Figure 7). 28% of the respondents choose that renewable energy keeps the environment healthy and clean. Therefore, this aspect of renewable energy could motivate them to buy renewable energy. 16% show that the main factor which can motivate them to buy renewable energy is energy saving. Other factors are energy security (6%) and reliability of green energy (4.7%). In our sample, residents' buying behavior is greatly influenced by economic factors. They choose price as the main barrier in buying renewable energy and are told that if there are government subsidies, they will become motivated to pay for renewable energy.

4. Discussion and policy implications

Research findings indicate that respondents have great interest and exhibit a positive attitude towards renewable energy. Most respondents are worried about environmental problems and stated that compared to conventional electricity, renewable energy has many benefits such as environment protection from carbon emissions and improved energy structure. Thus, renewable energy has significant demand potential among Chinese consumers. However, results also show that residents are influenced more by economic factors, i.e., price, than environmental factors.

It was revealed that high costs, lack of awareness, limited subsidies, social norms, and confusing policies regarding renewable energy were the major barriers to buying

renewable electricity. All stakeholders should increase residents' awareness about renewable energy in a coherent and integrated manner. The government should launch subsidy programs to increase the participation of local dwellers. In addition, clear and transparent policies will play a critical role in enhancing residents' WTP for renewable energy and winning public support from a long-term perspective. There is an immediate need to emphasize the adverse environmental impacts of conventional energy and advocate the positive benefits of renewable energy government, Non-government Organizations (NGOs) and policymakers. This may be accomplished by establishing ecological awareness activities that stress the significance of lowering greenhouse gas emissions, conserving energy, and implementing environmentally friendly energy-generating methods.

Solar energy has a competitive advantage regarding life span, price, maintenance, and operation expenses over other renewable technologies in China. Khalil and Zaidi (2014) compared the life cycle assessment of solar PV and wind turbines and revealed that the average life span of wind turbines is 10–15 years, while it is 25 years for solar PV. Additionally, wind power plants require operational and maintenance costs of PKR 3.5/h while solar PV doesn't require any operation and maintenance costs. Similarly, the cost needed to generate 1 kWh of wind electricity is PKR 120,000, while it is only PKR 65,000 in the case of solar PV. Therefore, it is crucial to make effective strategies to balance the life cycle costs of wind power plants and solar PV. This can be done by achieving the state-of-the-art technology and giving tax reductions on importing specialized wind power equipment.

The government of China introduced the "Net Metering Policy" in 2015 to help small solar PV and wind power projects. According to this scheme, solar PV and wind power projects under the capacity of 1 MW will sell electricity to the national grid. Domestic users and industry owners can benefit from this scheme if they fulfil the requirements set by the National Electric Power Regulatory Authority (NEPRA) (Irfan et al., 2019a, 2019b, 2019c). Related government policies are also needed to support other renewable technologies like small hydro and biomass energy.

Furthermore, state departments and enterprises involved in the commercialization of renewable energy technologies can also take insights from this research as the renewable industry is in its infancy in China (Irfan et al., 2021; Li et al., 2022). Various elements, such as high price, risk perception, and perception about neighbors' participation, obstruct consumers from selecting it over traditional electricity. Organizations must focus on the social, environmental, and economic benefits of green energy to diminish these factors. It is urgent to build strong government-industry ties to ensure that government policy goals for integrating renewable energy into the country's entire energy mix are generating the desired outcomes. For the full commercialization of green energy technology, businesses need to adjust their strategy by adopting novel business strategies. In this aspect, the cheap initial cost of such technologies might be advantageous.

5. Conclusions

In this study, we have examined the public acceptance of renewable energy deployment in China. The possible factors which affect inhabitants' WTP for renewable

energy were identified. The results of the Logit regression model revealed that there is great public support for renewable energy utilization. Most people exhibit positive WTP for green energy, and this positive intention increases with residents' income, education, awareness, and positive belief about the renewable energy consumption cost. On the other hand, respondents' age has the opposite effect on willingness to pay, as WTP decreases with individuals' age. Young and educated people tend to have more WTP for renewable energy, are more concerned about the environment and believe that renewable energy consumption produces extra costs. Therefore, policymakers must make their strategies by keeping young and educated people in mind to win their support. Research findings also revealed that the main barriers to the adoption of renewable energy are high prices, lack of awareness, limited government subsidies, social norms and confusing government policies, while the key factors that can motivate respondents to pay for renewable energy are the allocation government subsidies, reliability, energy security, energy saving, and environmentally friendliness nature of renewable energy. By focusing on the examination of public acceptance of green energy deployment, research findings highlight the importance of advocating renewable energy benefits, enhancing public awareness, announcing transparent policies, allocating subsidies, and developing effective financing mechanisms in an integrative and coherent way for the quick deployment of renewable energy in China.

The research also has some limitations. The selected study sample was relatively small for statistical analysis. Furthermore, four major cities of Shandong province were selected with similar geographic and economic backgrounds. Therefore, the public acceptance of renewable energy for other regions was overlooked. Future studies shall expand the survey to other areas and provinces of the country to bridge this gap, as every renewable energy technology has different effects, benefits, and costs. Thus, subsequent studies should focus on examining the concrete development of various renewable technologies.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Author contributions

M. Ali: Conceptualization, writing—original draft. **M. I.:** Conceptualization, writing—original draft**. I. Ozturk:** Writing review and editing. **A. Rauf:** variable construction, methodology, formal analysis, data handling, Writing review and editing.

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The Institutional Review Board of Ilma University (Protocol code number: 436-2 on 26 April, 2022) has approved the study.

Informed consent statement

Informed consent was obtained from all matters belonging to this research study.

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Data availability statement

The data supporting to findings of this study are available from the first author upon reasonable request.

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