Not in My Backyard, but Not Far away from Me:

Local Acceptance of Wind Power in China

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Highlights:

We find the characteristics of local acceptance of wind energy in China and examine the independent variables based on the evidence from Jiuquan City.

We characterize the local acceptance of wind power in China as “not in my backyard, but not far away from me”.

The perceived economic benefits and the perceived environmental costs are the two most significant factors.

The public receives most of its information of the expected economic benefits and environmental costs associated with wind power from various governmental agencies.

Abstract: Local acceptance of wind energy technology has become an important factor to consider when designing local and national wind energy technological innovation policies. Previous studies have investigated the factors that shape the local acceptance of wind power in high-income countries. However, to the best of our knowledge, these factors had not been investigated in China. Utilizing a survey and quantitative analysis, we have identified the factors that are correlated with local acceptance of wind power in China. We conducted our study in the city of Jiuquan, Gansu Province, which currently possesses the largest installed capacity for wind power generation in China. Two factors, namely, perceived economic benefits and perceived environmental costs, influence local acceptance of wind power in China most significantly. Local acceptance of wind power in China can be described as "not in my backyard, but not far away from me." In other words, the acceptance rate is lowest when the source of wind power is located in their village or community, highest when the project is located in their county and city and decreases for projects that are constructed further away.

Keywords: local acceptance, wind power, NIMBYism, China

1. Introduction

1.1 Background

In 2010, China surpassed the United States to become the leading global energy consumer [1]. China's demand for energy continues to grow and, based on the International Energy Agency's energy demand scenarios, is expected to account for one-quarter of global energy consumption by 2035 [1]. According to the 12th Five-Year Plan for Renewable Energy Development, by 2015, China plans to produce 9.5% of its total energy consumption from renewable energy sources (an increase from 8.2% in 2012 and 5.7% since 2005). Based on a 2012 report produced by the Chinese Wind Energy Association, wind energy has surpassed nuclear power as the third largest energy source in China. The Chinese wind power industry dates to the end of the 1970s but the industry has grown dramatically since 2003 [2]. Between 2006 and 2010, China's installed wind capacity has grown at an annual rate exceeding 100% each year [3]. In 2010, China became the country with the largest installed wind capacity worldwide, with 41.8 GW[3]. According to the 12th Five-Year Plan for Renewable Energy Development, the Chinese government aims to build nine 10 GW wind power bases (including onshore and offshore projects), which will form the basis of government commitment to wind power [4]. Although wind energy is considered low-carbon energy technology, previous research also indicates that wind power projects are unappealing to the local populace if they are built in their neighborhoods because they produce noise and represent unattractive alterations to the landscape [5-10]. Wind energy is considered an unacceptable energy option in parts Europe and the United States because of these negative impacts. This phenomenon has been widely studied in the United States, Germany, Spain, Denmark, France, Italy, and Sweden, which are all

locations where social acceptance is a key factor in wind energy development [7, 11-13] and negative public perception has contributed to delayed and cancelled projects [14].

As wind power development has increased in China, an increasing number of incidents indicate public concern over the expansion of wind power [15-17]. In 2011, 370 people in Chifeng, which is located in the Inner Mongolia Autonomous Region, complained that the newly built wind power farms caused a drought that damaged grassland ecology [18]. In 2007, scholars in Jiangsu Province blamed wind power projects for bird deaths [16]. People who lived near the wind power project in Shandong Province complained that the wind turbines were too noisy [17]. Although there have been many public complaints about wind power projects in China, state and provincial governments have rarely taken action to address them. Furthermore, there is no system in place to include public input during the wind power plant planning and siting processes. While the central government is interested in the smooth development of the wind sector, their approach towards considering public opinion in the decision-making process is inconsistent across energy and industrial projects. The Chinese central government has worked to address public concerns about the environmental problems produced by P-Xylene industrial plants, but the government has not acted to address public concerns about wind development perhaps because it is a newer industry for which public concerns have only recently been voiced. By identifying the factors affecting local acceptance of wind power and which sources of information are perceived as authoritative, this paper can help the Chinese government contribute to social stability and a smoother, less controversial execution of its energy plans.

1.2 Determinants of local acceptance of wind power

Wolsink [9, 19, 20] and other scholars have argued that many factors affect public resistance of wind projects. We classify these factors into three categories: public attitudes toward environmental issues, perceived interests, and general attitude toward wind energy.

Previous studies have noted that economic benefits [21-23] and environmental costs shape the local acceptance of wind energy [5-10]. According to a National Wind Coordinating Committee research report, the deployment of wind power in China provides direct economic benefits for localities, including increasing incomes for local government and landowners, increasing employment opportunities, and increasing demand for local commodities and services during project construction and operation [23]. Jobert et al. [21] argued that economic incentives are important factors affecting community acceptance of wind power in Denmark. Previous research observes that the main reasons for local opposition to the construction of wind farms in high-income countries are noise and visual intrusion [5-10, 24]. Bell et al. [25] argue that perceptions of high local environmental costs produce the "social gap" between the high and stable levels of public support for renewable energy generally and the low success rate of planning applications for wind power developments.

Wind energy development is driven by the desire to rely upon more sustainable energy sources. The relationship between public attitudes toward environmental issues and renewable energy development has proven to be somewhat complex [26]. "On the one hand, support for renewable energy policies is led by a desire to reduce the human impact on the environment by endorsing energy conservation and renewable energy technologies. On the other hand, people concerned about the human impact on the

environment, worry about the consequences that renewable energy technologies might have on the local flora and fauna" [27]. Previous studies indicate that the local acceptance of wind energy is directly related to public attitudes toward environmental issues, such as climate change, and feelings of personal responsibility to address such problems [26, 28-30]. For example, Swofford and Slattery [30] link wind energy attitudes to local environmental values. Their study indicated that people who are more concerned about climate change and environmental issues are more likely express positive attitudes toward wind energy [30].

The general attitude of the public toward wind power is another key factor influencing local acceptance of wind energy [31, 32]. Wolsink [25] proposed that public attitudes toward wind power are fundamentally different from attitudes toward wind power projects [33]. Bell et al. [25] note that an "individual gap" exists when an person has a positive attitude toward wind power in general but actively opposes a particular wind power project. (In this view, the "individual gap" is different from the "social gap" that describes the social phenomenon). However, other studies observe that general attitudes toward wind power influence the acceptance of wind power—that is, people who have a more positive attitude toward wind power are more likely to accept specific wind projects [31, 32].

1.3 NIMBYism and Beyond

The NIMBY (Not in My Backyard) phenomenon has been utilized to describe and explain opposition to wind power by many authors [6, 34]. Some researchers utilize NIMBYism to explain general support for renewable energy development and opposition to specific projects because of perceived noise and visual impacts in the UK, Denmark, and Ireland [6, 33]. However, other scholars argue that NIMBYism cannot

explain local acceptance of either renewable energy generally or wind energy specifically. These claims are centered on two criticisms. First, criticism of the proximity hypothesis, which expects that those who live closest to a wind farm have the most negative attitude toward it, argues that this hypothesis cannot be tested empirically. Some scholars have even argued that public attitudes toward wind energy are not related to distance [35, 36]. Vander Loo [36] coined the term PIMBY (Please in My Back Yard) to refer to instances in which wind turbines are viewed positively as a source of income. Other scholars have observed that individuals living closest to renewable energy projects tend to have more positive attitudes than those living further away [8]. Second, scholars claim that NIMBYism oversimplifies attitudes toward wind power [37, 38]. NIMBYism is grounded in a rational actor model of individuals, which assumes that human behavior is based on selfishness, ignorance or a narrowly conceived view of the world [37, 38]. Opponents argue that local acceptance of wind power is motivated not only by rational choice or selfishness [37, 38, 25] but also by values, environmental beliefs, institutions, and other contextual, social and psychological factors [37, 39, 40].

1.4 Renewable Energy Development and Environmental Justice

Environmental justice has also been used to explain the social acceptance of renewable energy [7, 39, 41-43]. In practice, environmental justice refers to a socio-political movement focusing on the fair distribution of environmental benefits and burdens that originated in the United States during the early 1980s. The U.S. Environmental Protection Agency defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, sex, national origin, or income with respect to the development, implementation and enforcement of

environmental laws, regulations, and policies." Environmental justice is not only concerned with the distribution of environmental benefits and burdens among the members of a society or community but also with procedural justice by emphasizing the fairness and processes by which decisions are made [7, 39, 44]. Some scholars have noted that environmental justice problems may arise during the development of renewable energy projects and have examined the relationship between renewable energy development and environmental justice [39, 41, 43]. For example, Outka [41] argues that environmental justice not only focuses on the site decision of renewable energy but also influences the definition of renewable and clean energy in laws. Procedural justice has been studied as an important issue in the development of wind energy in Australia and Germany; studies indicate that processes that are more inclusive can contribute to increased social acceptance [39, 43].

Based on this previous research, we integrate both interest variables, such as perceived costs and benefits, and belief variables, such as general attitudes toward environmental issues and wind energy into the analysis (Figure 1). One key result is the identification of the distance from the farm at which perceived economic benefits begin to compensate for perceived costs.

1.5 Research Objectives

Both research addressing the role of social acceptance in the deployment of wind power in high-income OECD countries and news reports of public concern about the perceived negative impacts of wind energy in China point to the importance of considering social, political, and cultural views as well as technological and economic factors when developing renewable energy plans. With an increased number of wind power projects being planned and built, the public is beginning to experience the

benefits and costs of wind power development in China. The social acceptance of wind energy may shape future wind energy development in China although the Chinese government has historically experienced less difficulty implementing infrastructure projects than other governments have.

The social acceptance of renewable energy technologies has affected the evolution of wind deployment in industrialized countries and has emerged as a possible factor in shaping the industry's future in China; however, the authors are not aware of any studies that investigate social acceptance issues in China or the driving forces of these issues. Our research investigates the local acceptance of wind power projects at the village, county, city, province and national levels. Our goal is to answer the following questions through quantitative analysis: **What are the characteristics of local acceptance of wind power in China?** and **What factors affect local acceptance of wind power in China?** In Section 2, we introduce the survey methodology and geographic area of focus. In Section 3, we present the results of the survey. In Section 4, we compare our findings with those of previous studies. Finally, in Section 5, we conclude and describe some policy implications. Based on the literature review and research questions, we include interest variables, such as perceived costs and benefits, and belief variables, such as general attitudes toward environmental issues and wind energy in the analysis (Figure 1).

2. Material and methods

We conducted a survey in the city of Jiuquan to examine local acceptance of wind power in China. This survey investigated the following factors of local wind power acceptance: (1) the role of different distances, that is, the distance of the project from

the community or village, county, city, province and country; (2) the impact of perceived benefits, public attitudes toward environmental issues and general attitudes toward wind energy; and (3) the extent to which different types of information diminish or exacerbate public concerns about wind power development in different locations.

2.1 Sample and collection method

The Gansu Province is one of the areas in China with the strongest wind resources. Located in the western part of the Hexi Corridor, the Jiuquan area of Gansu has the potential to generate at least 40 GWa from wind power [4](Li et al, 2011). Among the eight 10 GW wind power bases in China, the Jiuquan Wind Power Base was the first project built with national approval. As of April 2013, this plant was also the largest wind power project in China. Once completed, the Jiuquan Wind Power Base will be the first 10 GW scale wind power base in the world. It will also become a landmark project for the Chinese West Development Plan along with the West-East Gas Transmission, Oil Transportation from West to East, West-East Electricity Transmission Project, Qinghai-Tibet Railway, and Three Gorges with Wind Power projects. Compared to the coastal regions, northeastern region, Inner Mongolia, Xinjiang and other provinces with relatively abundant energy resources, Jiuquan possesses unique advantages and characteristics. Under the jurisdiction of Jiuquan, Guazhou County is the so-called wind reserve of the world, while Yumen is the wind outlet of the world.

Located in western China, Jiuquan stretches over 192,000 km^2 (42% of the area of the Gansu Province) with a population of 1.1 million inhabitants. The locations of Jiuquan and Gansu are displayed in Figure 2. To investigate the public perception of wind power in Jiuquan, we randomly selected 21 communities in the city and conducted a survey between January 8th and January 31th, 2013. Households within each

community were selected randomly. There were no restrictions on the participant population in terms of gender, income, or education level; however, only participants over 18 years of age were included. To ensure the validity and reliability of the data, respondents were provided with a written explanation of the survey. After reading this information, respondents were given the opportunity to ask questions about the survey before completing the questionnaire. Of the 1,300 questionnaires distributed, 698 valid responses were received, an effective response rate of 53.7%.

A potential problem associated with the survey is that non-response produced sample selection bias. For example, as we discuss in section 3.1, the proportion of respondents with tertiary education is quite high. It is possible that respondents who provided valid questionnaires were more highly educated, and therefore, our sample may be biased towards highly educated people. While this does not invalidate the results of this study, it is important to note that our sample was on average more educated than the overall population in Jiuquan. In addition, younger people were more likely to complete questionnaires; our results are more representative of younger people than of the population.

2.2 Questionnaire and Data Analysis Methods

The questionnaire consisted of three sections (Table 1). The first section collected demographic characteristics, including age, education level, income per month, and asked whether the respondent was a resident of the area under review. The second section contained measured the respondents' perceived interests, public attitudes toward environmental issues and general attitudes toward wind energy using a 7-point Likert-type scales (i.e., 7: strongly agree, 1: strongly disagree), which would be used as independent variables in our statistical models. The third section contained questions

about the local acceptance of wind power within the respondents' community or village, county, city, province and country, which would be used as dependent variables in our statistical models. The 7-point Likert-type scale was also used in this section (7: strongly accept, 1: strongly reject). A summary of the second and third sections (independent and dependent variables) is presented in Table 1. We did not control for whether the respondent resided at a particular distance from an existing wind farm. We assume that self-reported preference does not depend on whether a person lives close to a wind turbine.

We analyzed the data using SPSS for Windows (namely PASW Statistics 18.0 for Windows). The statistical techniques applied are descriptive analysis, factor analysis and regression analysis.

3. Results

The results are presented in three parts: (1) a description of the sample and local acceptance of wind power; (2) the results of the factor analysis of the initial independent variables; and (3) the results of the regression analysis of the clustered factors (independent variables) and local acceptance of wind power within different geographic ranges.

3.1 Description of local acceptance of wind power

The final sample was 60.6% male and 39.4% female. The majority of respondents (87%) was 45 years of age or younger. The sample is largely representative of permanent residents (89%). More than half of respondents had at least one higher education degree—bachelors, masters, or doctorate (52%).Our survey is generally

representative of younger (under 45 years old) and more educated individuals[1]. Of the respondents, 79.4% reported monthly incomes greater than 2,000 yuan.

Our first goal was to investigate the local acceptance of wind power at different proximities, namely, within the community (village), county, city (Jiuquan), province (Gansu), and country (China). These are the five dependent variables in the regressions. As illustrated in Figure 3, respondents have a high acceptance of wind power overall. Of the respondents, 60.5% accept wind farms (defined as the combination of respondents answering somewhat accept + accept + strongly accept) in their community or village. The percentage of respondents who accept wind power projects built in the county and city levels are highest, 81.2% and 79.9%, respectively (Figure 3). When the geographic distance increases, acceptance of wind power projects decreases to 67.7% in Gansu and 64.4% in China (Figure 3). The acceptance of wind power projects follows an inverted U-shape with increasing distance.

Figure 4 indicates that most respondents did not believe wind turbines would produce excessive noise (88.2%), destruction of landscape (86.7%), or negative impacts on their living environment (85.4%) as measured by the sum of somewhat disagree, disagree, and strongly disagree responses. In contrast, 83.4% of respondents agreed (defined hereafter as the sum of somewhat agree + agree + strongly agree respondents) that wind farms would provide income growth for local families, and over one-half of respondents (52.7%) agreed that wind farms would boost local employment growth.

As indicated in Figure 5, majority of respondents agreed that environmental protection is very important to them (93.2%) and to China (92%). Moreover, 95.3% of respondents cared about global climate change. Unsurprisingly, given these results, the fraction of respondents that agreed that China should develop renewable energy was 89.1%.

On the whole, respondents had positive attitudes toward wind power (Figure 6). More than 90% of respondents agreed that wind energy technology is beneficial to the optimization of the Chinese energy mix, environmental protection and economic growth in China (93.2%, 92.7%, and 92%, respectively). In addition, a large percentage of respondents agreed that wind energy technology is more readily available (88.4%) and more cost effective (85.4%) than other renewable energy technologies. However, nearly half of respondents (48.2%) considered wind energy unreliable because of its intermittency.

As displayed in Table 2, the general public in Jiuquan obtains almost all of its information about the expected economic benefits and environmental costs associated with wind power from national government agencies and local government agencies (city and county levels), while independent experts from universities and think tanks contribute marginally to public knowledge about wind power (Table 2). Television and the internet are the main channels from which the public obtains information about economic benefits and environmental costs (Table 3).

3.2 Factor Analysis of Initial Independent Variables

Based on the literature review, our survey included 16 questions to evaluate the factors that can affect local perceptions (shown in Table 4). Our analysis suggests that these 16 questions can be clustered into three initial independent variables: perceived interest, public attitudes toward environmental issues, and general attitudes toward wind energy. To facilitate the interpretation of the regression results, we first conducted a factor analysis.

The KMO value for the perceived interest variables is 0.819, which indicates that the partial correlations among variables are substantial and sample size is adequate. A

Bartlett test identified two factors with eigenvalues greater than 1. Table 4 indicates that the two factors explain 72.4% of the total variance. Table 5 displays the factor matrix after rotation. The six questions for the perceived interest variables can be classified into two factors and clustered as perceived economic benefits and perceived environmental costs (Factor 1 represents options 1 to 4 as "perceived environmental costs;" Factor 2 represents options 5 and 6 as "perceived economic benefits").

The KMO value for environmental attitude variables is 0.809. A Bartlett test identified one factor with an eigenvalue greater than 1. The results presented in Table 4 indicate that two factors explain 71.6% of the total variance. Table 6 displays the factor matrix after rotation. Four questions can be combined into one factor, which we identified as "public attitudes toward environmental issues" (Factor 3).

The KMO value for general attitudes toward wind energy is 0.858 (i.e., greater than 0.70). A Bartlett test identified one factor with an eigenvalue greater than 1. Table 4 indicates that two factors explain 64% of the total variance. Table 7 displays the factor matrix after rotation. Four questions can be combined into one factor identified as "general attitudes toward wind energy" (Factor 4). Four factors can be extracted and utilized in the regression analysis.

3.3 Regression Analysis

The multiple regression analysis then explores the factors affecting local acceptance of wind power. As noted in Section 3.2, we identified four factors using factor analysis. These four factors are perceived environmental costs (X_1), perceived economic benefits (X_2), public attitudes toward environmental issues (X_3), and general attitudes toward wind energy (X_4), which are independent variables in the regression models. The dependent variables (Yi) are the rates of local acceptance of wind power

for respondents in three counties at the following locations: community (village) (i=1), county (i=2), city (i=3), province (i=4) and country (i=5).

$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \mu_i$ (i=1,2,3,4,5, also denote Models 1-5)

Model 1 captures the factors that affect the local acceptance of wind energy within a community or village (Table 8). The results of model 1 indicate that perceived economic benefits are associated with an increase in acceptance (p = 0.000). Perceived economic benefits have a high impact on local acceptance of wind power within the community or village. The p-value of the environmental concern impact on acceptance is 0.051, suggesting that perceived environmental costs can have a marginally significant effect on local acceptance a within a community or village.

Model 2 takes the acceptance of wind power at the county level as the dependent variable and includes the same independent variables as model 1 (Table 8). The corresponding p-value of the perceived environmental costs, perceived economic benefits, and public attitudes toward environmental issues are less than 0.05, which indicates that those variables are associated with increased acceptance of wind power at the county level. However, general attitudes toward wind energy do not have a significant influence on local acceptance.

Model 3 takes local acceptance of wind power built within Jiuquan as the dependent variable and includes the same independent variables as models 1 and 2 (Table 8). The corresponding p-values of perceived economic benefits and public attitudes toward environmental issues are less than 0.05, which indicates significant statistical significance and associations with increased acceptance of wind power in Jiuquan. However, general attitudes toward wind energy do not have a significant influence on the local acceptance of wind power at the city level.

Model 4 captures the factors that affect the local acceptance of wind power built within the Gansu Province (Table 8). The *p*-values of perceived economic benefits, public attitudes toward environmental issues and general attitude toward wind energy are all greater than 0.05, which means that none of these three factors are statistically significant. However, perceived environmental costs have a significant influence on the level of local acceptance of wind power within the Gansu Province.

Model 5 captures the factors that affect the local acceptance of wind power built within China, which also includes the same set of four independent variables. The *p*-values of perceived economic benefits, public attitudes toward environmental issues and general attitudes toward wind energy are all greater than 0.05, which are not statistically significant. Again, perceptions of environmental costs are statistically significant associated with the local acceptance of wind power built within China.

4. Discussion

4.1 Not In My Back Yard but not far away from me

Over the past twenty years, a debate between "Not In My Back Yard" disputes and "Beyond Not In My Back Yard" views has become an important focus of research on the social acceptance of wind energy, in particular, and of renewable energy more broadly. This disagreement is due to the different explanatory variables emphasized in previous studies. This study observes that local acceptance of wind power plants across different geographic domains is described by an inverse U-shape. The data analysis above indicates that the public has the lowest acceptance (60.5%) when wind farms are located in their village or community. A slightly higher rate of acceptance appears in Jiuquan than the percentage observed for respondents who support wind farms on their

property (46.6%) based on Swofford and Slattery's work [30]. Although this is a comparatively high number, the results indicate that this is actually the lowest level of acceptance across geographic locations (county, city, province, and state). The public has the highest acceptance of wind power when projects are developed within their county and city. Acceptance decreases for projects being built further away from them, namely, in other areas of Gansu or China. We thus characterize the attitudes of Jiuquan citizens toward the construction of wind farms as "not in my backyard but not far away from me". Scholars who examine NIMBYism often overlook the economic benefits of wind power projects, while other scholars who reach opposite conclusions neglect the fact that local residents can indeed perceive the environmental costs of wind power. This finding helps explain both the negative and the positive effects produced by wind power, which may affect the acceptance of wind power. The perceived negative effects of wind power plants, such as noise pollution, visual impact, and other environmental costs contribute to the NIMBY phenomenon, but the perceived local economic benefits increase positive responses for wind farm developments at the county level more than those that are further away. The Jiuquan wind power plant is one of nine 10 GW wind power plants planned in China; it is also currently the largest wind power construction project in China. The "not far away from me" aspect can be explained by the large scale of wind power development plants in Jiuquan being perceived as potential driver of a local wind power industrial chain—especially for the development of wind power equipment manufacturing. This, in turn, could promote both employment growth and growth in per-capita earnings in Jiuquan. Therefore, public acceptance of wind power in Jiuquan could be considered rational overall in the desire to avoid the costs wind power farms but also by wishing to benefit from the positive outcomes produced by the wind power industry.

4.2 Factors influencing local acceptance of wind power

Previous research has utilized interviews of small groups of stakeholders to uncover the importance of expected economic benefits in shaping public acceptance of wind power [21, 22, 23 (Jobert et al., 2007; Jakobsen, 2008; NWCC, 1997). Through a combination of factor analysis and regression analysis, we have validated this conclusion: the citizens of Jiuquan's strong beliefs about the economic benefits of wind power shaped their acceptance of wind power, especially at the local (village), county, and Jiuquan City levels. The perception of benefits was the most important factor in local acceptance. In developing countries such as China, the public seems to devote more attention to whether the proximity of industrial development (in this case, the wind energy industry) can yield economic benefits. This could explain the higher rate of acceptance (60.5%) in Jiuquan compared to the rate observed in Texas (46.6%) by Swofford and Slattery [30]. The manner through which the local public reaps the economic benefits from wind power in China differs from that in high-income countries. In many of the high-income countries, such as Denmark, France and the United Kingdom, wind power companies often involve individual citizens in the ownership of wind turbines to increase the local acceptance of wind power and avoid a NIMBY reaction [21, 22, 46](Jobert et al., 2007; Jakobsen, 2008; Warren and McFadyen, 2008). In contrast, wind power generation companies in China are all state-owned enterprises; therefore, individual citizens are not involved in the ownership of wind turbines. Citizens only benefit from employment and income growth that the turbines produce.

The Gansu Province is a relatively underdeveloped province in western China, which may contribute to the importance of expected economic benefits as a driver of wind power acceptance. As expected, the results confirmed that the greater the

perceived environmental costs of wind power (noise pollution, visual impact), the lower its acceptance rate in China. This conclusion is also consistent with previous research and reinforces the fact that perceptions about the negative externalities of wind power are also important in emerging economies, such as China's. We also observe that perceived economic benefits start compensating for perceived costs at the county and city levels. The perceived environmental costs associated with the development of wind power projects are positively correlated with the public's acceptance of wind power projects built far away from them (elsewhere in the Gansu Province and in other Chinese provinces). Through this empirical study, we have determined that public attitudes toward environmental issues only significantly affect local acceptance when considered at the city level (Model 3). Significantly, the public's general attitude toward wind energy has no explanatory power in any of the models considered.

5. Conclusion and policy implication

Between 2007 and 2013, several public protests against P-Xylene encouraged the Chinese government to address public acceptance to maintain social stability. Therefore, identifying the characteristics of local acceptance for wind power in China can help the Chinese government to design mechanisms, create a process involving the local population, or create informational campaigns to increase support for wind projects and contribute to smoother, less controversial realization of energy plans.

With a planned capacity of 10 GW, the Jiuquan wind power base has received government approval to become China's largest wind power base. The development of Chinese wind power has followed a typical pattern of government-driven technology. Although the Chinese government has a greater ability to implement industrial plans in the face of public opposition compared to other countries, evidence from other

industries suggests reducing public unrest associated with wind projects may be of future interest. With increasing wind power projects being built in China, local acceptance is likely to become an important factor influencing Chinese wind energy development.

In this paper, the lowest acceptance is for wind farms in Jiuquan is observed for projects built in the community (the village level) and the highest acceptance is observed for farms built at the county and city levels (higher than elsewhere in the Gansu province or other parts of China). We have characterized this phenomenon as **not in my backyard but not far away from me**. Based on this quantitative study, we also observe that perceived economic benefits and environmental cost are the most important factors affecting local acceptance of wind power in China. These findings provide evidence for China to the body of literature addressing the NIMBY phenomenon. In contrast to other countries, we find that local public in Jiuquan obtains almost all its information about the expected economic benefits and environmental costs associated with wind power from governmental agencies. This fact calls for Chinese government action to enhance the local acceptance of wind power. A limitation of this study is that we capture the perspectives of the younger and highly educated population; future research should compensate for this incomplete representativeness.

Our research produces several implications for policymakers and wind project developers. First, wind power plants should be sited, if possible, in sparsely populated areas. Based on the evidence from Jiuquan, the public in China supports wind power projects that are built within their county and city but not within their community or village. We have also determined that the optimal location of wind farms for Jiuquan in habitants would be within a county or city but not within a community or village. The government and developers should assess potential noise and visual impacts during the

process of planning. Wind turbines should be sited after considering the scale of the proposed wind farm, and specific geographical features of the proposed site, and public concerns.

Second, wind power developers should prioritize hiring local residents. Wind energy development in Sweden increased employment across the entire country. Wind farms have been responsible for an increase in employment in plant operations, maintenance, and manufacturing [47]. In China, local acceptance of wind power is mainly dependent upon the perceived economic benefits. Each link in the wind energy industrial chain may create jobs, which could enhance local employment and increase public acceptance of wind power. Local policy makers and developers would also benefit from providing training in related skills to increase the financial benefits of building of a power plant nearby.

Third, policymakers and developers should engage local residents and provide information about economic benefits and environmental costs. Overall, policymakers and developers do not currently engage with local residents when siting wind energy development projects. The history of wind power development in France and Germany suggests that local acceptance of wind power plants is crucially dependent upon both providing timely information about the project to the public and allowing public participation in the process (Jobert et al., 2007). Policymakers and developers should readily disseminate pertinent information about the impacts of wind energy to the public via media reports, informational meetings involving presentations by experts, local residents, and other stakeholders, and other available modes of communication.

Although there is currently no large anti-wind power movement in China, the government would be wise to pay attention to the local acceptance of wind power. The results and implications of our study suggest some lessons for wind power development

(mainly for onshore wind power development) to enhance the local acceptance of wind power and avoid future conflicts. Given the major role that the Chinese government sees for future wind power, understanding the factors that shape local acceptance can produce a smoother transition to a low-carbon energy sources.

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Footnotes

1. As shown in the appendix, mostly there is no significant difference between age groups (over 45, 45 and under), education levels (bachelors and above, less than bachelors) with respect to local acceptance of wind power within different geographic ranges. There are only significant differences between education levels in terms of local acceptance of wind power within the county (p value = 0.017) and within Jiuquan (p value = 0.004).

Appendix

T-test Analysis Results

	Age	**（N）**	**（Mean）**	**（Std. Deviation）**	**T value**	**P value**
Local acceptance of wind power within community or village	over 45	91	5.04	1.49	1.604	0.313
	45 or under 45	607	4.76	1.60		
Local acceptance of wind power within county	over 45	91	5.62	1.17	0.476	0.315
	45 or under 45	607	5.55	1.22		
Local acceptance of wind power within Jiuquan	over 45	91	5.48	1.27	-0.223	0.890
	45 or under 45	607	5.52	1.29		
Local acceptance of wind power within Gansu province	over 45	91	4.95	1.62	-0.885	0.345
	45 or under 45	607	5.10	1.54		
Local acceptance of wind power within China	over 45	91	4.70	1.75	-1.357	0.254
	45 or under 45	607	4.96	1.68		
	Education Level	**（N）**	**（Mean）**	**（Std. Deviation）**	**T value**	**P value**
Local acceptance of wind power within community or village	Bachelor degree and above	363	4.73	1.616	-1.079	0.281
	Under bachelor degree	335	4.86	1.559		
Local acceptance of wind power within county	Bachelor degree and above	363	5.66	1.213	2.387	0.017
	Under bachelor degree	335	5.44	1.21		
Local acceptance of wind power within Jiuquan	Bachelor degree and above	363	5.64	1.229	2.868	0.004
	Under bachelor degree	335	5.37	1.327		
Local acceptance of wind power within Gansu province	Bachelor degree and above	363	5.13	1.607	0.999	0.318
	Under bachelor degree	335	5.02	1.478		
Local acceptance of wind power within China	Bachelor degree and above	363	5.01	1.734	1.417	0.157
	Under bachelor degree	335	4.83	1.631		

Table 1 Summary of All Variables

Variables	Descriptions of Questions	Values
Independent variable 1: Perceived Interest	Wind farms bring noise pollution.	1-7，1：strongly disagree;7:strongly agree
	Wind farms have a negative impact to my living environment.	1-7，1：strongly disagree;7:strongly agree
	Wind farms are bad for the local scenery.	1-7，1：strongly disagree;7:strongly agree
	Wind farms are destructive to land use	1-7，1：strongly disagree;7:strongly agree
	Wind farms are positive for local family income growth.	1-7，1：strongly disagree;7:strongly agree
	Wind farms are positive for local employment growth.	1-7，1：strongly disagree;7:strongly agree
Independent variable 2: public attitudes towards environmental issues	Environmental protection is very important to me.	1-7，1：strongly disagree;7:strongly agree
	Environmental protection is very important to China.	1-7，1：strongly disagree;7:strongly agree
	I care about global climate change.	1-7，1：strongly disagree;7:strongly agree
	China should develop renewable energy.	1-7，1：strongly disagree;7:strongly agree
Independent variable 3: General attitudes toward wind energy	Wind technology is beneficial for Chinese e energy mix optimization.	1-7，1：strongly disagree;7:strongly agree
	Wind energy technology is beneficial for Chinese environmental protection.	1-7，1：strongly disagree;7:strongly agree
	Wind energy technology is beneficial for Chinese economic growth.	1-7，1：strongly disagree;7:strongly agree
	Wind technology is more readily available than other renewable energy technologies.	1-7，1：strongly disagree;7:strongly agree
	Wind technology is more economical than other renewable energy technologies.	1-7，1：strongly disagree;7:strongly agree
	Wind energy is unreliable (because sometimes there is no wind).	1-7，1：strongly disagree;7:strongly agree
Dependent Variable: Local acceptance of wind power	To what extend will you accept wind power if it was built within your community or village?	1-7，1：strongly reject;7:strongly accept
	To what extend will you accept wind power if it was built within your county (but not within your community or village)?	1-7，1：strongly reject;7:strongly accept
	To what extend will you accept wind power if it was built within Jiuquan City (but not within your county)?	1-7，1：strongly reject;7:strongly accept
	To what extend will you accept wind power if it was built within Gansu province (but not within Jiuquan City)?	1-7，1：strongly reject;7:strongly accept
	To what extend will you accept wind power if it was built within China (but not within Gansu province)?	1-7，1：strongly reject;7:strongly accept

Table 2 Information sources of economic benefits and environmental cost from wind power

	Information sources of economic benefits from wind power(%)	Information sources of environmental cost from wind power(%)
Central Goverenment	14.3	11.7
Provincial Goverenmtent	5.5	10.5
Jiuquan Goverenment	28.6	25.3
County Government	29.6	26.2
Enterprises	11.1	9.5
Experts	3.6	7.6
Relatives	3.1	3.9
Neighbour	1.7	1.9
Others	2.4	3.4

Note: Respondents were allowed to indicate multiple answer choices.

Table 3 Information channels of economic benefits and environmental cost from wind power

	Information channels of economic benefits from wind power(%)	Information channels of environmental cost from wind power(%)
Internet	25.6	21.9
TV	31.3	33.7
Broadcast	9.7	10.1
Newspapers	18.7	20
Magazines	3.1	3.8
Oral Introduction	5.2	4.4
Boards	5.9	5.6
Others	0.3	0.4

Note: Respondents were allowed to indicate multiple answer choices.

Table 4 Total Variance Explained (For Three Initial Independent Variables)

Initial Independent Variables		Initial Eigenvalue			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Perceived Benefits	1	3.506	50.092	50.092	3.506	50.092	50.092	3.506	50.082	50.082
	2	1.561	22.301	72.393	1.561	22.301	72.393	1.562	22.311	72.393
Public attitudes toward environmental issues	1	2.865	71.633	71.633	2.865	71.633	71.633	2.865	71.633	71.633
General attitudes towards wind energy	1	3.853	64.22	64.22	3.853	64.22	64.22	3.853	64.22	64.22

Extraction Method: Principal Component Analysis.

Table 5 Rotated Component Matrix (Perceived Benefits)

Item	Factor 1	Factor 2
Wind farms bring noise pollution	.937	.005
Wind farms have a negative impact to my living environment	.936	.000
Wind farms are bad to the local scenery	.931	.058
Wind farms are bad to the land use	.929	.031
Wind farms are positive for local family income growth	.050	.883
Wind farms are positive for local employment growth	-.126	.846

Extraction Method: Principal Component Analysis.

Table 6 Rotated Component Matrix (Public Attitudes toward Environmental Issues)

Item	Factor 1
Environmental protection is very important to me	.276
Environmental protection is very important to China	.306
I care about global climatic change	.305
China should develop renewable energy	.293

Extraction Method: Principal Component Analysis.

Table 7 Rotated Component Matrix (General attitudes towards wind energy)

Item	Factor 1
Wind technology is beneficial to Chinese energy structure adjustment	.231
Wind energy technology is beneficial to Chinese environmental protection	.224
Wind energy technology is beneficial to Chinese economic growth	.233
Wind technology is more conveniently applicable than other renewable energy technologies	.230
Wind technology is more economical than other renewable energy technologies	.220
Wind energy is unreliable (because no wind sometimes)	.017

Extraction Method: Principal Component Analysis.

Table 8 Regression Results

Variables and Statistics	Model 1(n=698)			Model 2(n=698)			Model 3(n=698)			Model 4(n=698)			Model 5(n=698)		
	B	t-value	p	B	t-value	p	B	t-value	p	B	t-value	p	B	t-value	p
Constant	4.795	82.109	0.000	5.559	130.115	0.000	5.511	118.461	0.000	5.079	87.793	0.000	4.927	77.989	0.000
Perceived Environmental Cost	-0.116	-1.959	0.051	-0.257	-5.919	0.000	-0.066	-1.395	0.164	0.156	2.656	0.008	0.207	3.217	0.001
Perceived Economic Benefits	0.326	5.159	0.000	0.238	5.158	0.000	0.264	5.249	0.000	0.112	1.790	0.074	0.082	1.199	0.231
Public Attitudes towards Environmental Issues	0.015	0.168	0.867	0.183	2.883	0.004	0.146	2.114	0.035	0.096	1.116	0.265	0.060	0.645	0.519
General Attitudes towards Wind Energy	0.091	1.007	0.314	0.034	0.520	0.603	0.059	0.823	0.411	0.086	0.955	0.340	0.118	1.210	0.227
	Model 1(n=698)			Model 2(n=698)			Model 3(n=698)			Model 4(n=698)			Model 5(n=698)		
R	0.250[a]			0.378[a]			0.297[a]			0.169[a]			0.163[a]		
R Square	0.062			0.143			0.088			0.029			0.027		
Adjusted R Square	0.057			0.138			0.083			0.023			0.021		
F	11.550			28.895			16.770			5.124			4.735		
Sig.	0.000[a]			0.000[a]			0.000[a]			0.000[a]			0.001[a]		

a. Predictors: (Constant), REGR factor score1 for analysis 6, REGR factor score 1 for analysis 4, REGR factor score 2 for analysis 4, REGR factor score 1 for analysis 5

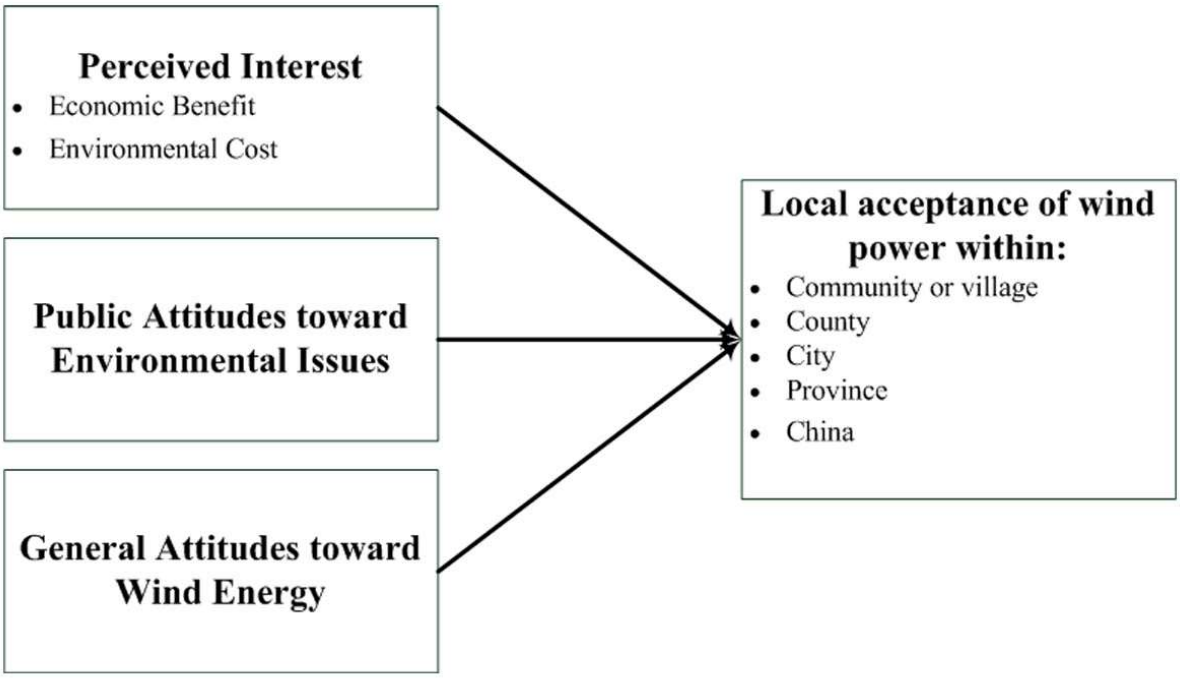

Figure 1: Schematic of factors that could shape the acceptance of wind power in China at different geographic scopes to be tested in this study.

Figure 2: Locations of Jiuquan City and Gansu province in China

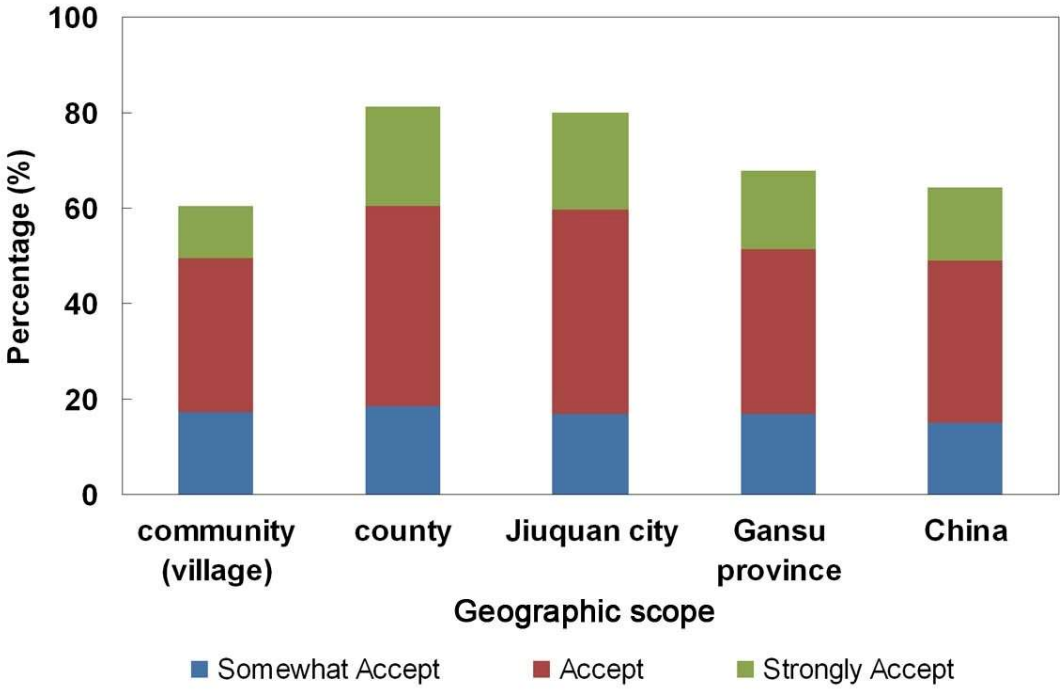

Figure 3: Acceptance of developing wind power at different geographic scopes.

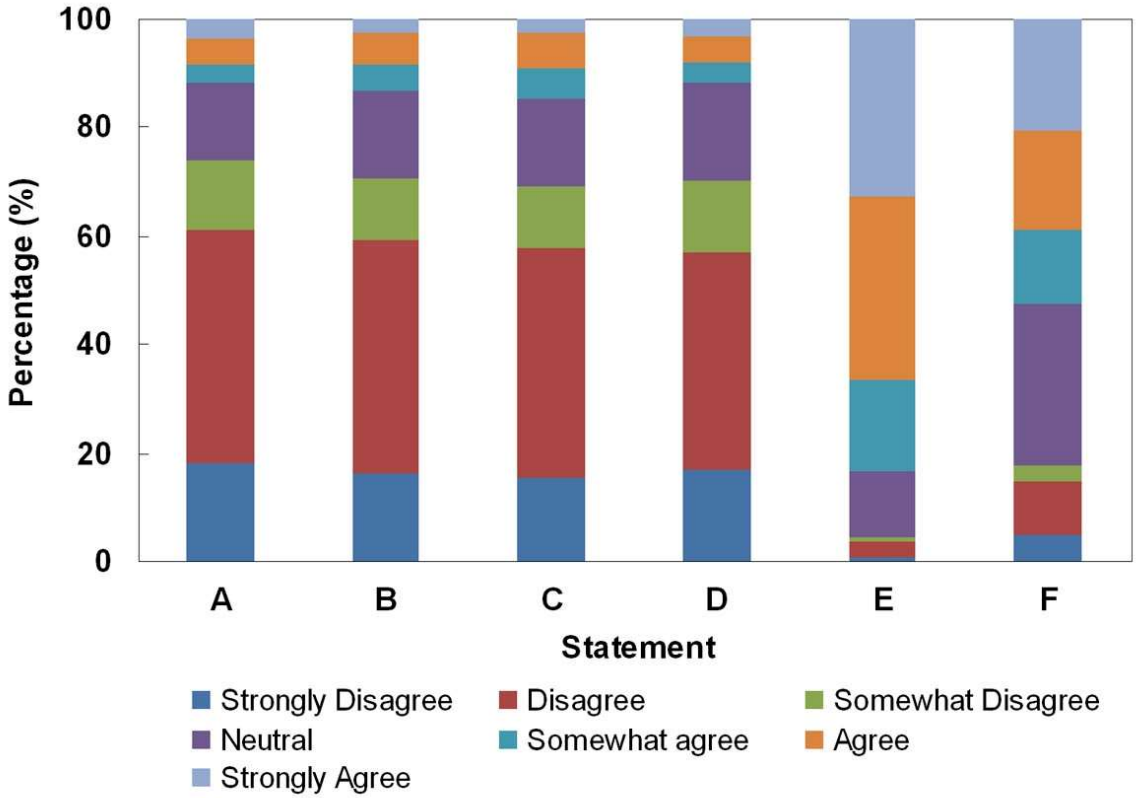

Figure 4. Perceived benefits of wind power. Statement A: wind farms bring noise pollution; statement B: wind farms have a negative impact to my living environment; Statement C: wind farms are bad to the local scenery; Statement D: wind farms are bad to the land use; Statement E: wind farms are positive for local familiy income growth; Statement F: wind farms are positive for local employment growth.

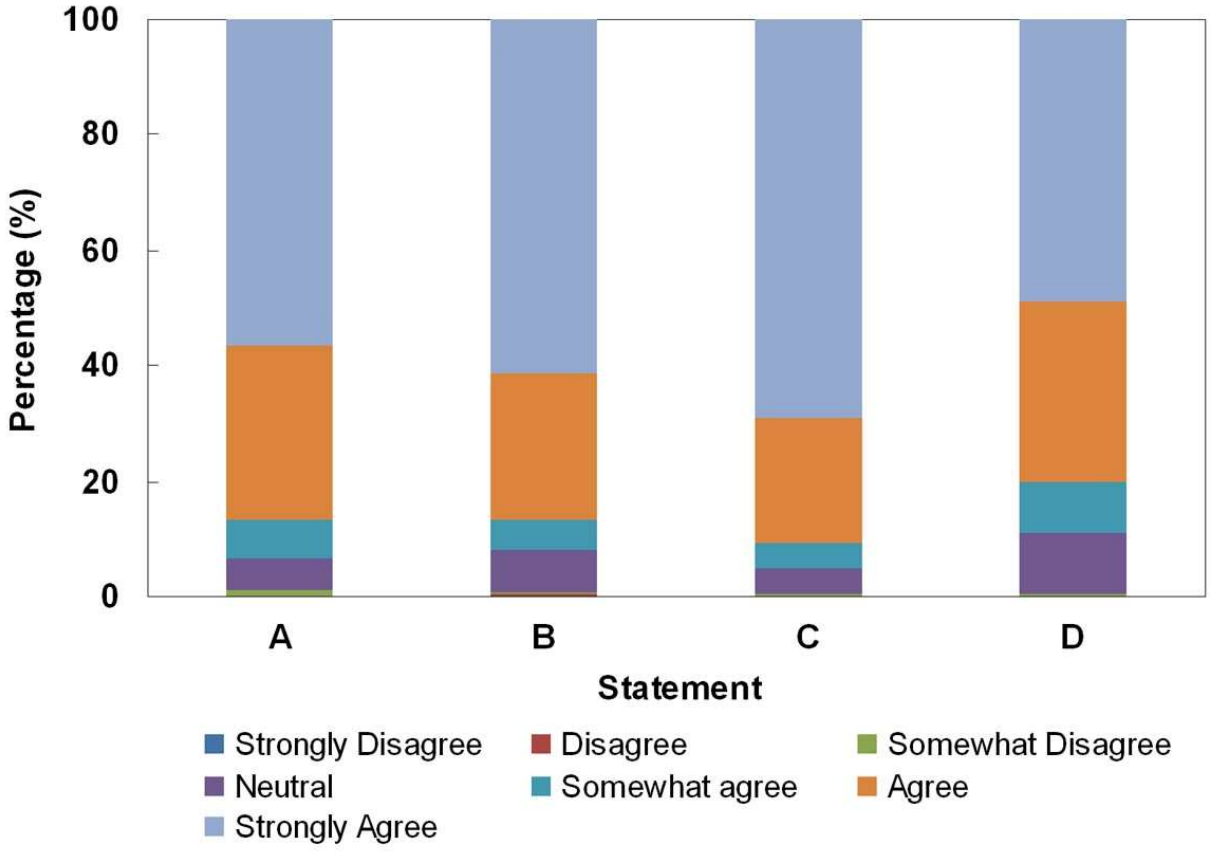

Figure 5: Public attitudes toward environmental issues. Statement A: environmental protection is very important to me; statement B: environmental protection is very important to China; statement C: I care about global climatic change; statement D: China should develop renewable energy.

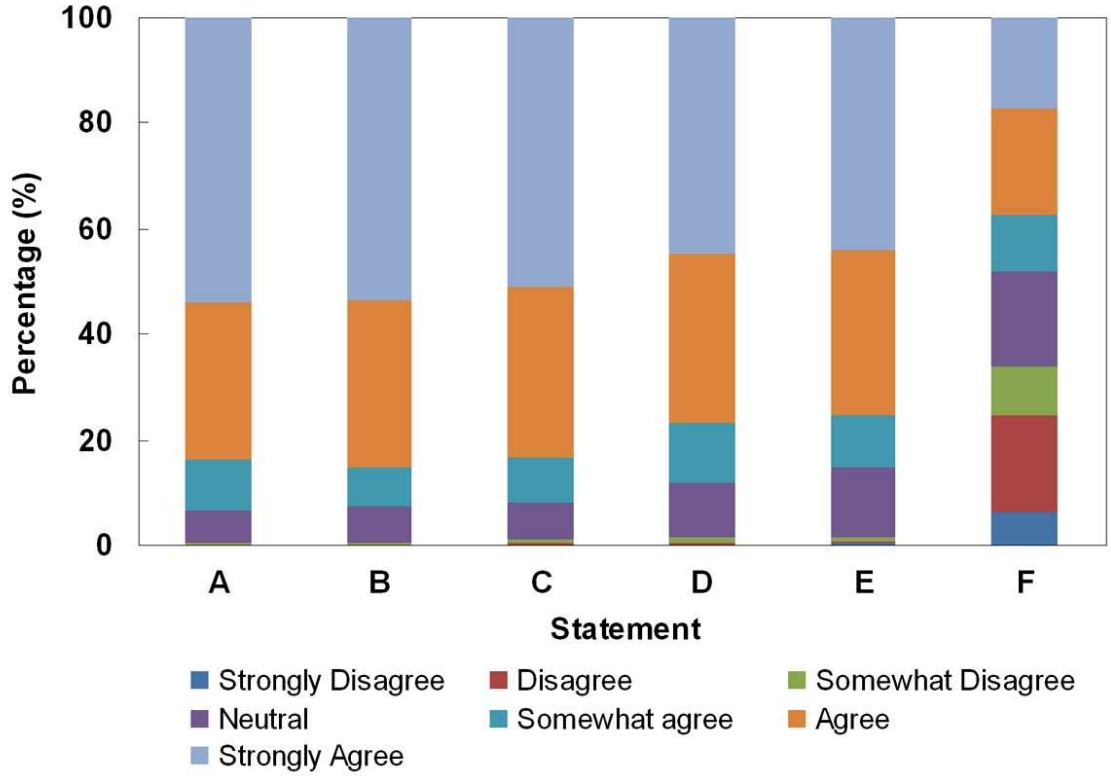

Figure 6: General attitudes towards wind energy. Statement A: wind power is beneficial for China's energy mix optimization; statement B: wind power is beneficial for China's environmental protection; statement C: wind power is beneficial for China's economic growth; statement D: wind power is more readily available than other renewable energy technologies; statement E: wind power is more cost effective than other renewable energy technologies; statement F: wind power is unreliable(because no wind sometimes).