

Carbon Capture and Storage Perceptions and Acceptance: A Survey of Chinese University Students

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Abstract. A survey of Chinese university students with regard to carbon capture and storage (CCS) was conducted in order to improve the understanding of public perception of CCS in China. A questionnaire was designed to evaluate the awareness, benefit and risk perception and the acceptance of CCS as well as respondents' trust in stakeholders. The results show that the respondents had relatively high level of awareness about CCS than most of other previously conducted surveys. The respondents perceived risks of CCS higher than benefits. Generally our respondents accepted the development of CCS in China, however, they went against the implementation of CCS projects near their houses. Regression analysis was conducted to reveal the correlation between the acceptance and factors of benefit perception, risk perception and trust and it shows that benefit perception and trust are the direct impact factors for the general acceptance of CCS.

Keywords: carbon capture and storage; risk perception; benefit perception; trust; acceptance

1. Introduction

Due to the double serious challenges from necessity of reducing CO₂ emission and simultaneous need to continue using coal as a major energy resource in China, it is necessary to intensify the development of carbon capture and storage, which has the potential to successfully cope with this kind of certain inconsistency. And from another point of view, it seems feasible for China to develop CCS both technically and geologically. According to existing researches, China has great opportunities for CO₂ capture in coal-fired power plants and a large theoretical and geographically dispersed geologic CO₂ storage capacity.

Public perception is one of the major factors, which impacts the widespread application of CCS. That's because large-scaled CCS projects will inevitably require massive construction of additional infrastructures such as CO₂ transportation pipelines and CO₂ storage sites which might have direct influence on people's daily life. What is more important is that there are potential risks to the environment and human health because of possible CO₂ leakage from transport pipelines or storage sites. The public perception of CCS in China has not yet been thoroughly investigated. Two previous studies[1,2] conducted in China with regard to CCS mainly focused on stakeholders' opinion which is very often totally different from that of the lay public. Under this circumstance, we conducted a survey to well understand Chinese public perceptions and acceptance of CCS. Main aims of our research are: (1) to get additional information about public awareness, perceptions and acceptance of CCS in China; (2) to analyze the influence factors for the acceptance of CCS.

2. Method and Process of the Survey

Our survey is based on a structured questionnaire and a page containing information about CCS is added in the questionnaire to assist the respondents to form their opinions about CCS. We chose Chinese university students as our respondents with an integrated consideration of the next assumptions: (1) Basing on previous

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researches, general public in China have little knowledge about CCS. (2) CCS is a new technology system, which is quite remote from the daily life of ordinary people, so it is difficult for them to give relevant, rational and worthwhile answers to the specialized questions about CCS. (3) University students have relatively good knowledge of new technologies and much stronger learning abilities, and as a result we can put more appropriate and deeper questions in our questionnaire. (4) University students is a rather large group that makes about 1.5% of the total population in China, so, to some extent, the survey results can adequately reflect the general perception of the whole Chinese society. Besides, each of our target university has its own digital student forum (Bulletin Board System), which can be viewed as definite advantage to our survey. We put the HTML link to our questionnaire on the digital forums and students who were interested in our survey could complete the questionnaire. A total of effective answers received were 1857.

3. Results of the Survey

3.1. Awareness of CCS

One question of the questionnaire asked if the respondents had heard about CCS or not. The results revealed that 45.9% had heard about CCS and only 1.5% stated that they are very familiar with CCS. In our survey the quantity of respondents who heard about CCS is relatively high in comparison with results of most of previously conducted researches. For example, an international research conducted in 2003 found that 22% of Japanese respondents and only 4% of American respondents confirmed that they heard about CCS before the survey. A survey of Japanese university students[3] found that 61% had little knowledge about CCS. In the Netherlands, Huijts et al.[4] found that 76% of the respondents indicated that their awareness level ranged from knowing nothing to knowing very little about CCS. Although these results cannot be fully accurately compared because of different time periods of the surveys, areas surveyed, survey methods and respondents types, we still can draw a conclusion that respondents in our survey are relatively high informed of CCS. We can also make a justified conclusion that higher level of general education usually means deep knowledge about CCS.

3.2. Benefit perception and risk perception of CCS

The application of new technologies brings both benefits and risks to the society. In this study we investigated the respondents' benefit perception under three cases which are benefit to society, benefit to future generations and benefit to oneself. The level of benefit perception on each case was tested on a five point scale from 1 (very insignificant) to 5 (very significant). The results show that benefit to society was perceived as the most significant benefit of CCS, and benefit to future generations and benefit to oneself were perceived much lower.

Risk is considered as an important factor influencing public acceptance of CCS deployment. In our study, we examined the respondents' risk perception under nine detailed risk cases using a five point scale ranging from 1 (no worry at all) to 5 (serious worry). From the results we know that for all of the nine risk items the respondents' average worry level is between 'a little worry' and 'serious worry'. The risk of an abrupt release of large amount of stored CO₂ is the most concerned risk and risk of bad effects on trees and plants is concerned as the least worried risk item.

By comparing the mean of benefit perception (3.57) with the mean of risk perception (4.13) we found risk perception much higher than benefit perception. In that case, our respondents focus more on risk issues than benefit with regard to CCS.

3.3. Trust on stakeholders

Trust in stakeholders is an important factor that might have effects on public acceptance of CCS. We explored respondents' trust in different kinds of stakeholders which are government, industry, environmental non-government organizations (NGOs) and scientists and engineers. The level of trust in each stakeholder was measured by using a five point scale from 1 (not trust at all) to 5 (strongly trust). The results show that our respondents have the highest trust in scientists and engineers (mean=3.48). Industry (mean=2.59) is least trusted by our respondents.

The level of trust in industry is generally quite low, which may be caused by the fact that industry is usually viewed as benefit-seeking and concerned about its own private interests much stronger than about public gain. However, industry is quite competitive in the investment and implementation of CCS projects, so that it seems very important to strengthen communication between public and industry to eliminate public bias against industry.

3.4. Acceptance of CCS

The acceptance of CCS is examined under two cases: (1) general acceptance of running CCS in China; (2) acceptance of CO₂ storage formation near your house. The acceptance level of each case was measured using a five point scale from 1 (not accept at all) to 5 (strongly accept). The results show that near a half of respondents chose the option of ‘accept’ or ‘strongly accept’ for the case of general application of CCS in China, however, only 17.5% accept the locating of CO₂ storage site near their houses. According to the average value of acceptance level, we find that our respondents are slightly positive on the acceptance of running CCS in China (mean=3.33) and strongly negative on the acceptance of locating CO₂ storage site near their houses (mean=2.33). Similar results were found in a previous study. Midden and Huijits[5] investigated people’s attitudes towards CO₂ storage in general and CO₂ storage in nearby areas by using a five point scale from 1 to 5. Their study showed that storage in general was judged rather positively (mean = 3.17) while nearby storage was evaluated on average rather negatively (mean = 2.54). From these results we know that the obvious ‘NIMBY’ (Not In My Backyard) effect exists in public opinions for the application of CCS.

4. Anaysis of the influencing factors for the acceptance of CCS

In order to explore the feature of connection between factors of benefit perception, risk perception, trust and people’s acceptance of CCS, a linear multiple regression analysis was proceeded by using SPSS software. Three hypotheses are presented first: H1: Risk perception has negative impact on the acceptance of CCS; H2: Benefit perception has positive impact on the acceptance of CCS; H3: Trust has positive impact on the acceptance of CCS.

We set ‘accept running CCS in China’ as the dependent variable and benefit perception, risk perception and trust as the independent variables. We used a step by step method to run regression analysis. The regression coefficients and Pearson correlations are shown in Table 1. From the results we find that variables of benefit perception and trust are in the regression model and both of their regression coefficients are positive which means that benefit perception and trust have significantly positive impact on the general acceptance of CCS. By observing the size of coefficients benefit perception is closer correlated with the general acceptance of CCS than trust.

We did another regression analysis by setting ‘acceptance of CO₂ storage formation near your house’ as the dependent variable in order to explore if there are any differences of the regression results between general acceptance and the acceptance nearby. Independent variables remained the same. The second regression analysis show that all the three independent variables are in the regression model (see Table 1), which means that benefit perception, risk perception and trust have direct influence on the acceptance of running CCS nearby. We also find that trust became the maximum impact factor under this circumstance.

Table 1: Regression analysis predicting the acceptance of CCS from benefit perception, risk perception and trust

Independent variables	Regression predicting general acceptance of CCS		Regression predicting acceptance of CCS nearby	
	Regression coefficients	Pearson Correlation (N=1857)	Regression coefficients	Pearson Correlation (N=1857)
Benefit perception	.507	.554**	.362	.402**
Trust	.352	.480**	.421	.419**
Risk perception	-	-	-.176	-.146**
R Square	.370		.240	

** . Correlation is significant at the 0.01 level (2-tailed).

The relation among acceptance of running CCS nearby and benefit perception, risk perception and trust can be reflected by Fig. 1. According to the results of regression analysis, some conclusions can be drawn

with regard to the three hypotheses mentioned at the beginning of this section: Firstly, as for the general acceptance of running CCS in China, hypothesis a and c are well demonstrated and hypothesis b is rejected; Secondly, as for the acceptance of running CCS nearby, hypothesis a, b, and c are all well demonstrated.

5. Conclusions

This study aims to improve the understanding of public perceptions of CCS in China. The main findings are as follows: (1) 45.9% respondents stated to have heard of CCS. (2) Considering the benefits of CCS, the respondents perceived the benefit to society more significantly than the benefit to future generations and themselves. The most concerned risks in our respondents' opinions are connected with unexpected accidents such as sudden release of large amount of CO₂ or severe facility damage because of earthquakes, the least concerned risks are about bad effects on ecosystems induced by CO₂ leakage. Risk of CCS was perceived much higher than its benefit. Among four types of stakeholders scientists and engineers are highest trusted and industry was least trusted. (3) The respondents held slightly positive attitude towards the general acceptance of CCS development in China, however, they went against the locating of CCS projects near their houses. Regression analysis revealed that benefit perception and trust are directly related with the general acceptance of running CCS in China, and as to the acceptance of running CCS projects nearby, benefit perception, risk perception and trust are all directly related with it.

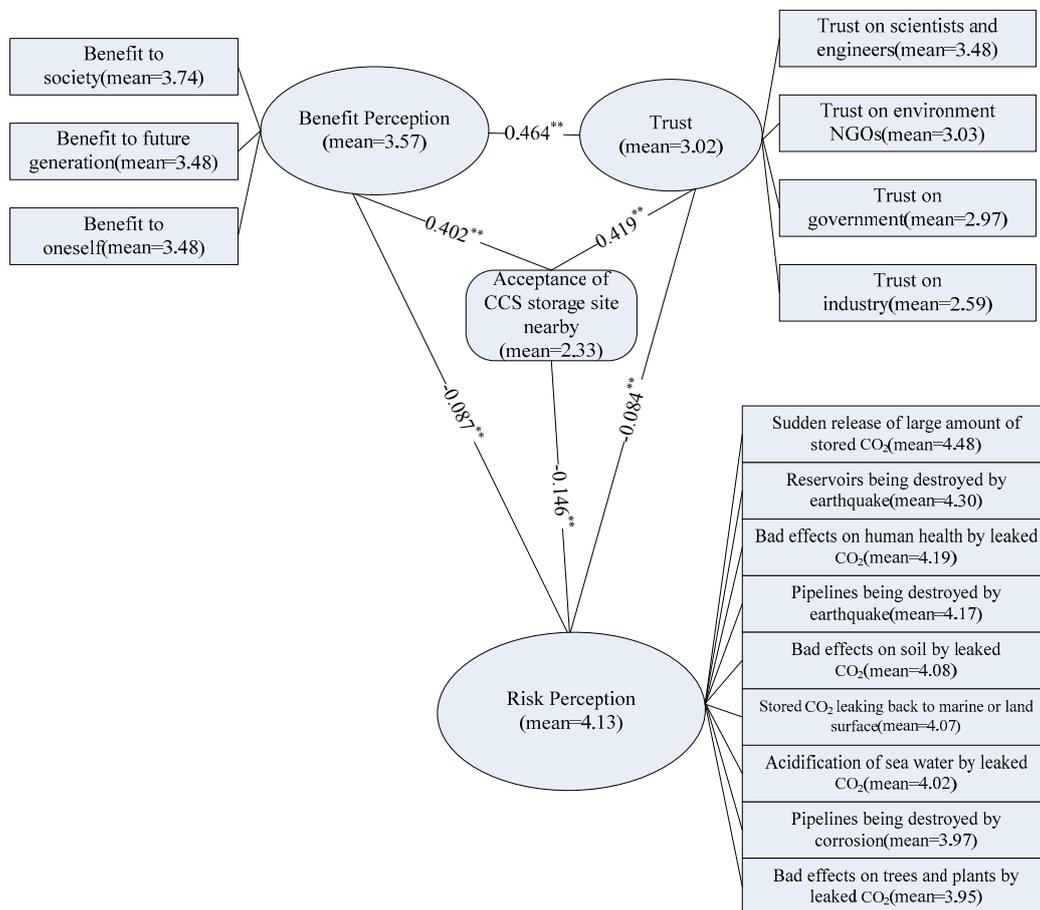


Fig. 1. Relation among benefit perception, risk perception, trust and the acceptance of running CCS nearby

6. References

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