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Stakeholder acceptance of carbon capture and storage in Germany

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Abstract

This paper presents the results of a collaborative project on public acceptance of Carbon Capture and Storage (CCS) in Germany, commissioned by the German Federal Ministry of Economics and Technology (BMWi). The project "Socio-economic Research on Acceptance of CCS" (April 2006 to March 2008) analyzed various aspects of public acceptance of CCS mainly in the national context of Germany. It was the first project to handle this subject matter. Public acceptance is one of the crucial factors for the implementation of CCS in the future.

Keywords: Stakeholders opinion, Media analysis, Acceptance in Germany, CCS

1. Introduction

The main objective of the present research was to understand the relevance of technical and non-technical aspects of CCS in terms of social acceptance. The project analyzed risk potential, risk perception, legal aspects and media coverage of CCS. Furthermore, it investigated the stakeholders' opinions concerning the potential and necessity of the technologies as new climate change mitigation opportunities. In the following, the methods applied and the conclusions reached on the basis of the empirical results of the project will be described.

2. Methology

The project mainly focused on the national context of Germany and was based on three main work procedures: 1) Literature and document analysis to give an overview on risk potential, risk perception and legal aspects along CCS

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process chains. 2) Media analysis, concentrating on daily or weekly newspapers and magazines in Germany to gather information on trends in media coverage of CCS. 3) Analysis of stakeholders' opinions, using a specially designed questionnaire to survey the attitudes of energy experts, students, journalists and environmental non-governmental organizations. Furthermore, in-depth interviews were conducted with selected stakeholders who were regarded as public multipliers.

3. Results

With respect to the social acceptance of CCS in Germany, the theoretical part of this project (literature and document analysis) did not identify any risk or legal aspect that could be interpreted as general barrier to the deployment of the technologies.

In addition to the risk analysis, this new technology branch was put into comparison with other power generation technologies such as nuclear power, wind energy or natural gas storage. The latter is the most similar to carbon dioxide storage. Nevertheless, the most important experience in this context is the experience with nuclear power in Germany. The opposition against nuclear energy emerged simultaneously with its use. Nuclear energy was perceived even more frightening being used for civil electricity generation than for military purposes. The first groups opposing vehemently were motivated by local reasons. It was not the technology itself that caused the negative emotions, it was the local plant that was rejected (so-called NIMBY-Effect: Not In My Backyard). People felt personally affected. The anti-nuclear movement grew quickly denying categorically the usefulness of the technology. At the end, the public resistance was so strong that new projects were abandoned and the German Federal Government negotiated the phasing out of the nuclear energy in 2000. Another important issue in this context is safety, or rather the risk perception. The major accidents of Harrisburg and Tchernobyl showed a definite break in the public acceptance of nuclear power. And even the highest possible safety standards do not lead to more appeasement among the Germans. It seems appropriate that these two experiences – first opposition is due to local resistance and more safety measure do not lead to less risk perception – can be connected to CCS. The opposition nowadays against new fossil fuelled power plants is primarily the rejection of the use of coal and not of CCS technologies as such.

The media analysis showed a comparatively balanced media coverage of CCS in newspapers (positive, neutral and negative valuations were found), in which the arguments focused mainly on additional energy demand, costs of CCS and security of energy supply. Therefore an integrated and comprehensive description of all aspects concerning CCS was not part of the German media coverage.

The results of the survey and the interviews with stakeholders revealed specific positions by different societal groups. As in other countries, the government, industry and energy experts mainly take a neutral or positive view towards CCS. The experts named economic feasibility and public acceptance as the most relevant barriers to the implementation of CCS-technologies, followed by legal issues, policy aspects, risk aspects and technology feasibility (see Fig.1).

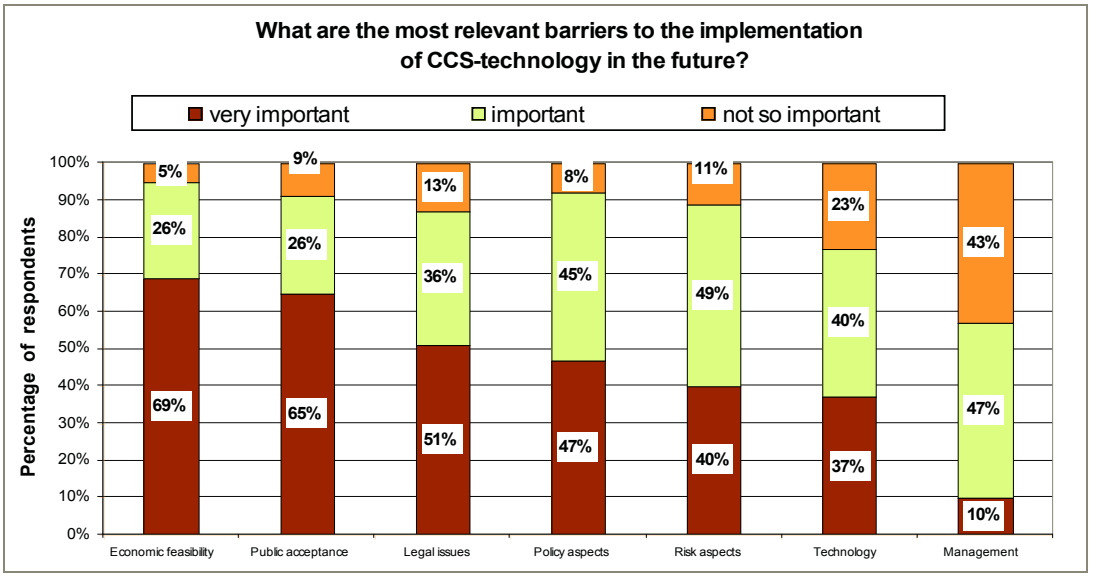

Fig.1 Experts (total number 232) responded the question: "What are the most relevant barriers to the implementation of CCS-technology in the future?"

Most environmental NGOs reject CCS, except for two that expressed conditional support. Concerning the attitudes of the German public, the multipliers confirmed that at present the majority is neither for nor against CCS. They assumed that the level of awareness about CCS among the public is very low or non-existent. In addition to that, other important stakeholders and public multipliers were asked on what they think that the public opinion would be. Target groups were representatives of the larger political parties, consumers' associations, trade unions, the two largest churches and scientific experts. The first group of topics for the interviewees referred to technical maturity, profitability, date of commercial availability of the technologies, their necessity (in Germany, Europe and globally), safety aspects, transport issues, permission of sites and responsibility of involved actors. Then they were also asked about the attitude of their own body or institution, and the third group of questions was related to the public's level of awareness about CCS, the media coverage of CCS, and facts that have a major impact on the public opinion (for example climate change). The majority of interviewees is convinced that the research on CO_2 storage should be intensified to affirm a safe keeping of CO_2. But also CO_2 capture technologies have to be improved. Technical efficiency has to be improved and the costs of CCS-technologies have to decrease for a higher competitiveness. The economic feasibility of CCS depends on many factors, especially on CO_2 prices in the future. The interviewees pointed out that CCS technology is not yet mature, it may come too late to contribute to far reaching greenhouse gas emissions reductions. There is no imperative to introduce CCS in Germany, but some stakeholders mentioned the global aspect of the technology (growing energy demand in China, India etc.). They agreed that CCS will only function as a bridge technology being useful as long as renewable energies cannot cover the global energy demand.

The large majority of stakeholders is convinced that the public acceptance of CCS will play a crucial role for its introduction. "CCS will not be a technical, but rather a social debate", one stakeholder declared referring to the risks. All interview partners pleaded for early and complete reports on CCS, a transparent risk communication and an open public dialogue on the technology. Hence, one pivotal question is how communication on CCS can be improved to better predict future public support or opposition.

4. Discussion

The assessment of hazard potentials and risks does not identify safety aspects that could yield to a general ban of carbon capture in power plants, transport of carbon dioxide or the subsequent storage. The applications of the capture technologies are already covered by existing measures of health, safety and environmental risk monitoring in industry. Hazard potentials during undisturbed or disturbed operation are comparable to those in other large-scale industries. Small-scale operations show 0.00032 incidents per year and km without any injuries or fatalities for

disturbed operation. For larger scales, figures can be estimated in analogy to natural gas transport. Although explosion risk during CO_2 transportation is much smaller than for natural gas, the hazard potential might be higher due to the higher density of CO_2 (accumulation in hollow areas) and the toxicity of H_2S (impurity of the captured CO_2 gas stream).

The estimation of hazard potential during storage is difficult, because especially on long-term stability there is no information available. Leakage can occur spontaneously or creepingly. Injection well failures or leakage up abandoned boreholes could create a sudden and rapid release of CO_2. The amount of CO_2 released is likely to be very small compared to the total amount injected. These types of hazards are managed effectively on a regular basis in the oil and gas industry using engineering and administrative controls. Creeping leakage could occur through undetected faults, fractures or through leaking wells where the release to the surface is more gradual and diffuse. In this case, hazards primarily affect freshwater aquifers and ecosystems where CO_2 accumulates in the zone between the surface and the top of the water table. When the potential leakage routes are known, the monitoring and remediation strategy can be adapted to address the potential leakage. Besides monitoring, emergency strategies must be developed. Altogether high demand on research and demonstration activities can be identified.

Hazards and risks connected to the introduction of CCS into the existing energy system are different but not implicitly higher compared to other existing large-scale technologies. The novelty of the technology could affect the permission and introduction of CCS technology and affect its acceptance. Public risk perception is one of the crucial factors for the public acceptance of CCS. At present, the German public has not yet any risk perception on CCS, because most members of the public do not have any knowledge about the technologies. In which direction the risk perception will develop in the future is uncertain, due to the early maturity stage of the CCS technologies. During the technologies' development and testing it will be essential to attend the emerging risk perception by specific risk communication strategies. It will be necessary to:

- develop dialogue procedures, in which expert estimations concerning the "objective" hazard potentials and intentions of policy decision-makers will be aligned with the perception and concerns of the broad public,
- take concerns of the population that are connected with the addressed hazard potentials seriously and take these perceptions during the communication processes into account,
- communicate the risks of CCS as a challenge and show possible solutions,
- take factors and processes (e.g. trust, assessment of properties of the risk source and risk situation, cultural context) which influence the public intuitive risk perception of CCS into account
- communicate explicitly the source of information about the technology and its hazard potentials, so that the citizens can evaluate the reliability of the sender,
- communicate the risks in a target group-specific way,
- communicate the complex nature of CCS adequately in the media, with balanced information about risks and chances.

As a first step, risk communication strategies should be tested and improved in combination with CCS pilot plants and demonstration projects and should then be further concretized based on the gained experiences.

Beside technical aspects, risk perception and specific risk communication, legal aspects (especially the question of liability) are important for the acceptance. This is especially true for CCS technology due to its novelty. The EU directive, which was published as draft version in the beginning of 2008 sees CCS-technologies as very important. It sets the regulatory framework for national legislation. The definition in an article or CCS law must consider the following policies:

- Included in the geological storage of CO_2 is also its commercial use for recovery of hydrocarbons,
- According to the OSPAR Convention storage of CO_2 underneath the sea bed (in natural gas fields and saline aquifers) is allowed, but not in the water-column and on the seabed. Additional necessity for regulation lies in the purity of the CO_2 stream.
- The exploration of possible storage sites needs permission.
- The access to storage and transportation systems must be non-discriminating, as well as the access to exploration.
- CCS will not be obligatory for the set-up of new power plants. Nevertheless, for a retrofitting the power plants must be "capture-ready", which means at least enough spare area for future capture and compression equipment.
- Several EU directives will be adjusted (waste directive, water framework directive). CCS was explicitly excluded from the scope of the waste law, and for the water law an exception was defined.
- In the long run, the specific member state will take on the responsibility for the geological storage after its shutdown. The definition and assignment of risks needs further regulation.

5. Conclusion

A perception of risks of Carbon Capture and Storage among the German public is virtually non-existent, since up to now according existing studies most members of the public do not have any knowledge about CCS. The document analysis showed furthermore a range of possible barriers for public acceptance, comprising the NIMBY effect and the perception of CCS as end-of-pipe technology competing with renewable energies.

However, the empirical results of this project illustrate that besides an intuitive risk perception of new infrastructure elements (e.g. pipelines, storage sites), increasing energy costs and a higher consumption of resources due to CCS technologies could result in a negative attitude regarding CCS.

The media analysis showed the need of a integrated and comprehensive description of all aspects concerning CCS within the German media coverage. For the future discussion of CCS, neutral and transparent information strategies on the technologies and its contribution to climate protection were identified as important elements.

The results of the survey and the interviews of the stakeholders revealed specific positions held by different societal groups. As in other countries, the government, industry and energy experts mainly take a neutral or positive view of CCS while most environmental NGOs reject CCS. Concerning the attitudes of the German public, the multipliers confirmed that at present the majority is neither for nor against CCS.