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# Public perceptions of CCS in context: results of *NearCO<sub>2</sub>* focus groups in the UK, Belgium, the Netherlands, Germany, Spain and Poland

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## Abstract

This paper presents initial findings from focus groups with the general public, conducted as part of the European (FP7) *NearCO<sub>2</sub>* project on public perceptions and understanding of CCS in six European countries. The research design specifically enabled the evolution of opinion to be observed in a relatively naturalistic setting. Each focus group was exposed to a specially-commissioned DVD that provided an overview of CCS, its rationale and arguments for and against CCS. Exposure was phased and a pre- and post-questionnaire was applied. The results concurred with much of the preceding work on CCS perceptions, namely a strong preference for renewable energy and a high level concern about the safety implications of CO<sub>2</sub> leakage. There were few strong differences between groups, with the exception of a higher level of concern about climate change in Spain, related to experience of drought. In all groups, concerns about safety quickly amplified and information on the difficulty in rapidly installing very high levels of renewable energy supply infrastructure had little influence on opinion. We conclude that the case for CCS, and reassurance on the risks posed by CO<sub>2</sub> leakage, will need to be made more convincingly and overtly, particularly for affected European publics. Moreover, in so far as the focus groups simulated the consequences of exposure to information on CCS without expert-moderation, they illustrate the importance of involving trusted parties in CCS communication processes, with the objective of moderating and responding to concerns as they arise.

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## 1. Introduction

Nearly a decade of previous research on public opinion of CCS has provided us with an indication of how people react when they are first introduced to the technology (e.g. Currey et al 2007; Miller et al 2007; Huijts et al. 2007; Shackley et al. 2006). This research has inclined us to expect: relative unfamiliarity with the technology and hence opinion change with increasing exposure to information; a preference for renewable energy and energy efficiency over CCS; reluctant acceptance of CCS, principally as a bridging technology; correlation of the level of acceptance and the level of climate change concern and perception of CCS benefits; a difference between in-principle and siting-related opinion, with opinion of proximate CO<sub>2</sub> storage characterised by significant concern over storage

risks; trust in, and communication with, technology managers and relevant institutions as important factors in public acceptance.

More generally, the literatures on risk perception, science and technology studies, social psychology and others suggest that public acceptance of CCS is unlikely to be a special case: despite particular characteristics, public perceptions of CCS are likely to be amenable to understanding within existing conceptual frameworks, albeit with some perspectives (e.g. risk perception) being more apposite in the case of CCS than in the case of renewables. This does not mean, however, that inferring from the environmental social science literature can or will secure public acceptance: informed understanding of public perceptions can help to formulate appropriate responses to public objection, and may help to mitigate or prevent objection, but it cannot guarantee to achieve any particular ends in terms of energy policy.

With this background and these caveats in mind, the European-funded (FP7) NearCO<sub>2</sub> project is investigating European public perceptions of CCS through case studies (both CCS and analogies), surveys and focus groups from spring 2009 through to early 2011. Research partners are the Energy research Centre of the Netherlands (ECN), the Institute for European Environmental Policy (IEEP), Judge Business School at the University of Cambridge, Tyndall Centre Manchester at the University of Manchester, Fraunhofer Institute for Systems and Innovation Research in Germany, and the Centre of Energy, Environmental and Technological Research (CIEMAT) in Spain. The overall aim of the project is to develop communication strategies and media that are designed to briefly convey to stakeholders and the public the advantages and risks of CO<sub>2</sub> capture and storage, and which may be used to involve these parties in local decision-making on CCS projects.

This paper describes the methods and results of six focus groups with the public, one held in each of the UK, Belgium, the Netherlands, Germany, Spain and Poland; it will be complemented by a later, theorised version.

## 2. Methodology

The groups were held in spring 2010 and participants were representative of national populations, not drawn from carbon storage localities (actual or planned). The objective was not to investigate the perceptions of people who have already been exposed to CCS information, but to investigate the development of opinion through the course of being exposed to new and additional information on CCS, with a view to informing communications strategies. A standardised prompt and information sheet was given to the facilitators to encourage common questioning, and the application of a pre- and post-focus group questionnaire was used to support further inferences on opinion and opinion change.

Central to the focus groups was a specially-produced DVD that explains CCS in the context of climate change and other energy options, and which has been translated into the six languages. The film aims to be as neutral as possible and provides an overview of arguments for and against CCS, including citizen concerns about the remote risk of harm to human health. The DVD is divided into several chapters, with discussion questions provided on-screen at the end of each chapter. The ‘CCS story’ builds progressively through the film, to elicit a phased response and to enable the influence of additional information to be observed.

In addition to the focus groups the participants were asked to complete a questionnaire before and after the discussions. This further aided the observation of the evolution of opinion and helped identify differences between the groups.

## 3. Results

### 3.1. *How do attitudes change in response to specific information introduced through the course of the discussion?*

In terms of attitudes to climate change, the focus group discussion and exposure to the DVD appear to have had only a minor impact on the participants’ perceptions and ideas. According to the pre and post focus group questionnaires, across the six case studies, fewer of the participants thought the risk of climate change outweighed the benefits (57.9% compared to 71.9%). However, analysis of the focus group transcripts suggests that the DVD was highly

stimulating and caused a high level of debate between the participants. Despite the questionnaire results suggesting that the participants were more sceptical about climate change after the focus group, the material certainly encouraged them to think about issues which they admitted to rarely giving much consideration. Nevertheless, as the discussions developed, an element of confusion and doubt about the veracity of climate change science was at times evident; this was particularly clear in both the German and Polish groups. Furthermore, while participants appeared to have quite strong opinions on climate change before the discussion, as the discussions developed and they listened to the opinions of others in the group, some of the participants started to question the validity of their own opinions.

In terms of opinion on CCS, the vast majority of the participants were largely unaware of the technology before attending the focus group. Initial reactions can be placed into three categories, interest/desire for more information, concern about safety and a good idea in the short term. As the participants were exposed to more information through the DVD, the discussions became characterised by a high level of confusion and uncertainty, in particular they were concerned about safety. Furthermore, the conversations regularly became stagnated when the participants were confused about a specific aspect of the technology. For example, in three of the groups there was a high level of uncertainty regarding the nature of CO<sub>2</sub> and whether it was explosive and a risk to human health. The high level of confusion let many of the participants to conclude that they didn't have enough information on CCS to support its development. In addition, many of the participants were worried about the time scales involved with CCS and felt it only represented a short term solution to the problem and that we would be better off investing in renewable energy. These largely negative thoughts about CCS were very much reflected in the answers given in the post-focus group questionnaire: 67% of the participants reported that they either strongly disagreed or disagreed with the use of CCS technology. That said, 80% of the participants stated that they either agreed or strongly agreed that more information was required about CCS before they could form an opinion. This was further supported by the focus group data, which showed that requests for more information occurred 77 times across the six case studies.

### *3.2 In what ways, if at all, do attitudes to CCS, climate change and energy demand and supply vary between the groups?*

With the exception of the Netherlands, between 70-100% of the respondents reported that they were concerned about climate change in the pre-focus group questionnaire. This was also reflected in the focus group discussions. Interestingly, the discussions about climate change in the Netherlands focused around the 'climate-gate' debacle that emerged just before the recent climate change conference in Copenhagen. It was clear that a number of the participants had been heavily influenced by the recent debates presented in the media.

The Participants in the Spanish focus group appeared to be particularly concerned about the impacts of climate change and repeatedly referred to the particularly hot summers they had experienced recently and increasingly regular water shortages.

Across all the case studies much of the discussions about climate change focused around the scale of the problem. In particular, many of the respondents felt that there was very little they could do as individuals or even as individual countries to tackle climate change. In all of the focus groups (except for Poland) the participants continually commented that they felt there was little point in 'us' taking action as countries such as China, India and the USA are unlikely to pull their weight.

According to the results of the pre-workshop questionnaire, in all the case studies (apart from Spain) the most important factor in determining which electricity production methods should be used was 'cost' (the Spanish participants considered helping to prevent climate change the most important). In particular participants in the UK, Germany and Poland, felt the costs associated with CCS were a major barrier to the implementation of the technology. The Polish focus group were particularly concerned about cost. They strongly felt that Poland was still a relatively poor country compared to other European nations and didn't have the money to invest in new technologies. Furthermore, all the participants (including the Spanish) felt very strongly that there is only a limited amount of money to spend on developing new energy technologies and we would be better off investing the money in renewables.

Prior to watching the DVD the participant's attitudes to CCS were largely consistent across all of the countries. People were clearly interested in the potential of the technology but concerned about the risks involved, particularly related to the long term storage of CO<sub>2</sub>.

As the discussions about CCS developed and more information was provided opinions on CCS started to become more diverse between the six countries. However, the overwhelming concern that participants didn't have enough information to make a decision remained constant across all the case studies. Participants from the UK and Netherlands were most supportive of the technology. In particular they thought that it represented a useful short term tool for reducing emissions while renewable technologies were developed. Participants from the remaining four case studies appeared to become more negative and confused about the technology as they were provided with information. In Germany, Spain, Poland and Belgium, the participants repeatedly asked questions suggesting that they understood CO<sub>2</sub> to be flammable, explosive and toxic (e.g. 'What happens if it explodes?' 'Will it pollute the earth's core?'). These confusions stimulated further conversations that went on to dominate much of the discussions, illustrating the importance of moderating information provision where possible, highlighting misconceptions that may be amenable to mitigation with more specific information provision, but also illustrating the more general problem of multiple interpretations of information released 'in the wild'.

### *3.3 In what ways, if at all, do contextual issues raised by participants differ between groups?*

Contextual issues appear to have had a limited impact on the findings from the research. Most significant was the higher than average concern about climate change reported by the Spanish participants which was accompanied by much more in depth description of the effects climate change is having on their lives. In particular, it was clear that water restrictions which have been strictly enforced across Spain in recent years have given the respondents an insight into the reality of climate change.

The general lack of knowledge about CCS held by all the participants led many of them to use existing technologies, which they were more familiar with as a frame of reference. Unsurprisingly, these frames of reference differed according to the local contexts. In the UK, Spain, Netherlands, Poland and Germany a direct comparison was made between the storage of nuclear waste and the storage of CO<sub>2</sub>. The Chernobyl nuclear power station disaster was quoted numerous times in Poland, Belgium and the UK. In Poland the participants appeared to be particularly nervous about nuclear waste, as Poland had suffered particularly badly as a result of the Chernobyl disaster. These fears about nuclear waste appeared to transcend to the disposal of other waste products from power generation, providing further evidence to support the argument that many of the participants failed to properly understand the nature of CO<sub>2</sub>. In contrast a number the participants from the UK argued that when people talk about nuclear power they automatically consider it to be dangerous because of Chernobyl. However, they went on to conclude that it was actually a relatively safe method of power generation and gave several examples, including Sellafield and Dungeness nuclear power stations in the UK which they felt had good safety records. This line of discussion eventually led some of the participants to argue that if the technology was in place to safely operate a nuclear power station, CCS should also be able to run safely.

In Belgium, Germany and the UK the examples of natural gas storage and transport were used by the participants to help them understand CCS. In the UK and Germany there was a general feeling that if natural gas could be stored safely and transported to people's homes, then the same should be possible with CO<sub>2</sub>. However, in Belgium, the Ghilenghien gas pipe explosion which killed 24 in 2004 was used as an example of how dangerous gas pipelines could be.

### *3.4 In what ways, if at all, do perceptions of risk vary between groups?*

As observed above, risk perception has become a key area of interest in understanding public perceptions of CCS. The Near CO<sub>2</sub> focus group participants were concerned about a wide range of risks associated with the technology, but these may be classified into three groups: physical risks (i.e. concerns about safety), financial risks and governance risks (i.e. concerns about the way the technology will be managed). While there were some differences

in the ways that the participants conceptualised risks relating to CCS across the six countries, the commonalities were more evident.

In terms of physical risks, the participants in all the case studies were most concerned about the storage aspect of the CCS chain. In total concerns about the risks involved with storing CO<sub>2</sub> were raised 58 times across all the focus groups compared to 24 times for transport and 3 times for the process of capturing the CO<sub>2</sub>. In particular, there was a general consensus that it would be impossible to guarantee that the CO<sub>2</sub> wouldn't leak out and that there is a danger that storing CO<sub>2</sub> could lead to significant problems for future generations. Many of the conversations focused on the potential impact of any leakage and were in a large part fuelled by the confusion about the nature of CO<sub>2</sub> identified above; a number of the participants appeared to think that CO<sub>2</sub> is highly flammable and/or explosive. In Poland and the UK specific concerns were also raised about the impact of future tectonic movement of on stored CO<sub>2</sub>. These concerns about the dangers CO<sub>2</sub> leakage prompted extensive discussions about locations for CO<sub>2</sub> storage. While the majority of participants were unhappy about any form of storage and particularly storage near their homes, others felt that providing appropriate risk assessments were conducted it might be acceptable to store CO<sub>2</sub> offshore. The post-focus group questionnaire revealed that 53% of the participants would be more accepting of offshore storage than storage on land. There was an interesting debate between a number of the participants in both the Polish and Dutch focus groups, with some arguing that they felt storing CO<sub>2</sub> offshore would be a safe short term solution and others arguing that 'dumping' waste at sea was dangerous as we don't know enough about the marine environment to predict the impact of leakage.

Concerns about the costs associated with both CCS and renewable energy technologies represented a significant area of debate in all the focus groups. There was a general consensus that new low carbon energy technologies will be expensive and in general people were unhappy about the prospects of higher energy bills. The Polish participants were particularly concerned about rising costs and pointed out that many people in Poland were already struggling to pay their energy bills. More specifically participants in all countries were concerned that the financial risks associated with CCS were significantly greater than with renewable technologies. Participants in the German and Belgian groups were concerned that if we invest in CCS now we still have to invest in renewables in the future, there was a general feeling that in the long run it would be cheaper to invest in renewables now. Furthermore, participants from the UK and Germany were particularly concerned about the long term costs of monitoring the stored CO<sub>2</sub>. These debates about cost led in to further discussions about who should pay for new technologies; there was a consensus that if CCS was to be deployed the bill should be predominately met by the power companies. However, the participants were equally sceptical that this would be the case, and felt it would inevitably lead to higher energy bills.

Risks associated with the governance of CCS also provoked a high level of debate and represents a major challenge for future public acceptability. The focus group data indicated that many of the participants trusted neither government nor industry to manage CCS objectively and safely, and according to the post-focus group questionnaire, only 25% said that they trusted either government or industry in relation to CCS. There was a general sense across all the focus groups that both industry and government were predominately interested in making money and less concerned about whether CCS represented the best solution to the CO<sub>2</sub> problem. Scientists were regarded as a more reliable source of independent information on CCS but there was concern that governments and industry were unlikely to act on scientific advice if it went against their interests. It was felt that governments were under a huge amount of pressure from oil industry lobbyists to find ways to extend our reliance on fossil fuels. Furthermore, a number of people from the UK and Spain commented that when it comes to environmental issues governments seem unable to either make or stick to international agreements, this led to a number of people arguing that there would be no point in a few countries developing expensive CCS projects without some kind of guarantee that high polluting countries such as the USA, India and China would also implement the technology. Participants from Belgium argued that CCS could potentially work across Europe providing sufficient leadership could be provided by the European Union.

### 3.5 *What, if any, demographic and other correlates are evident in the pre/post questionnaire?*

Due to the small size of the sample it is not possible to come to any conclusions regarding the impacts of demographics such as sex and age on perceptions of CCS or climate change. However, the post focus group questionnaire revealed that the male participants were slightly more willing to accept CCS than the females, there was no difference between males and females regarding perspectives on climate change. It also showed that there was no significant difference in perspective on either climate change or CCS when age was used as a control variable.

## 4. Analysis and conclusions

Overall, the focus groups suggest that many of the key findings of previous qualitative studies of CCS perceptions do apply across Europe. To reiterate: the general public are relatively unfamiliar with CCS, they have a preference for renewable energy over CCS; they have significant concern relating to the risks involved with storing CO<sub>2</sub> and they lack trust in the government or industry to make the right decisions about future deployment of CCS. In terms of international comparison and the influence of contextual issues, the difference in opinion between countries was minimal and many of the same issues occurred in all of the groups. However, there was some evidence to suggest that local contextual issues have some impact on perspectives. For example, a gas pipe explosion in 2004 in Belgium made some of the Belgian participants nervous about transporting CO<sub>2</sub> through pipelines. The research also revealed that the cost of deploying CCS and plans for its relatively short term use may also be barriers to public acceptance. A further significant finding, though not wholly unexpected, was that not only do people have a very low level of understanding about CCS but, they have very little knowledge of the nature of CO<sub>2</sub>. This appears to have played a major role in participants' thinking about CCS and contributed to a significant number of the participants turning against the technology. It is notable that this concern was more related to flammability and explosion than to asphyxiation.

In general, these findings are consistent with the increasingly popular discourse emerging from the 'risk society' literature which suggests that the perceived risks of new technologies often have far greater potential to undermine deployment than risk as scientifically-determined. As Giddens (1999) propounds, 'society is becoming more pre-occupied with the future (and safety)'. Consequently, people's initial response to a new technology or phenomenon is often dominated by concern. As Beck and Kropp (2007) note, today it is almost trivial to state that risk is a social construction. While this raises many questions about the nature of risk, which we will not address here, suffice it to say that risk perception has become culturally highly significant and that risk perception by the public has in many ways come to be more socially significant than risk in the probabilistic sense, as calculated by expertise.

That perceived risks tend to have a major impact on public perceptions of new technologies has important implications for the development of communications strategies on CCS. The primary stimulus for the focus group discussions was a neutral DVD that clearly explained the climate change problem, the challenges involved in producing low carbon energy and the CCS process. Although the participants did (in so far as observation permits) appear to understand the information in the DVD, this information also prompted them to ask further questions about the technology, to which answers were not readily available. The focus groups were facilitated by professional facilitators who, although provided with a common pre-defined script, had little knowledge about CCS, and who were not expected to be able to answer environmental questions or correct CCS-related misconceptions as they arose. This created a relatively naturalistic setting resembling a real-world situation, in which people are exposed to information on a new topic and to others' variously-informed opinions. This is clearly very different to controlled, psychological experiments, or to settings in which there is close moderation of discussion (as in, for example, a recent, as yet-unpublished citizens' panel study of public perceptions of CCS in the UK by Tyndall Manchester, involving experts who were available to answer questions as they arose).

Studying public opinion in a relatively natural context (though admittedly not as natural as an ethnographic method would permit) has provided complementary information on the evolution of public opinion on CCS following new exposure and on the particular ways in which concerns can amplify and develop in directions that to some extent involve misconception. While it should not be assumed that correcting these misconceptions would necessarily lead

to public support for CCS, the research design has revealed the need to reinforce and supplement information provision with trusted and timely mediation and interpretation. This should in principle be possible in site-specific and generic communications contexts. More difficult, perhaps, is the identification of exactly who such trusted experts might be, given the diversity of the public and the limited number and backgrounds of people who can speak with authority on the subject. There is also the added complication of (to some extent inherent) scientific uncertainties relating to storage and leakage. Nonetheless, validation of the general principle of the need for trusted and informed mediation of CCS messages, in addition to the observation that CCS-related public concerns are relatively generic and shared across Europe, remain the key contributions of this particular study.

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