

# **Scrutinizing the impact of CCS communication on the general and local public**

**Final project report**

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## Introduction

The project “Scrutinizing the impact of CCS communication on the general and local public (Impact of communication)” was initiated by the Fossil Energy Coalition’s (FENCO ERA-NET) 1<sup>st</sup> Joint Call for Proposals. It was led by Forschungszentrum Juelich GmbH, Institute of Energy Research, Systems Analysis and Technology Evaluation (IEF-STE) and consisted of eleven partners from six countries (cf. Table 1).

**Table 1: Consortium of the project “Impact of communication”**

Partner	Country
Forschungszentrum Jülich GmbH, Institute of Energy Research, Systems Analysis and Technology Evaluation (IEF-STE) - Coordinator	Germany
Wuppertal Institute for Climate, Environment and Energy	Germany
Centre for Research and Technology Hellas/Institute for Solid Fuels Technology and Application (CERTH/ISFTA)	Greece
University of Macedonia, Economic and Social Sciences Department of Applied Informatics	Greece
Leiden University	The Netherlands
Stiftelsen SINTEF	Norway
Natural Environment Research Council (British Geological Survey)	The United Kingdom
University of Cambridge	The United Kingdom
National Institute of Marine Geology and Geoecology (GeoEcoMar)	Romania
Institute for Studies and Power Engineering	Romania
National School of Political Studies and Public Administration	Romania

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Point of departure of the project was the assumption that public acceptance is an important precondition for the large-scale deployment of CCS. However, it was clear at the outset of the project that the public awareness of CCS was likely to be low and the opinions of general public would be unstable and uninformed because of the lack of knowledge on the topic and technologies of CCS. Hence, the pivotal research question was how information on CCS has to be communicated in order to increase the stability and consistency of public opinion to better predict future public support or opposition.

The main assumption of the project was that communication on CCS should enable the public to develop their own well-informed and well-considered opinion on the technologies. Thus, the aim of the project was to develop recommendations for the communication of CCS which would enable the public to establish well-informed and well-considered opinions. For this purpose two main methods were applied in all countries:

1. a comparative study of CCS communication methods (focus group discussions (FGD) and Information-Choice Questionnaire (ICQ)) and
2. a representative survey of citizens in order to investigate the awareness and knowledge of the public concerning climate change, energy policy and CCS.

This research approach of the project was implemented in four work packages (cf. Table 2).

**Table 2: Work packages of the project “Impact of communication”**

Work package	Leader
WP1: Coordination and Management	Forschungszentrum Jülich GmbH, Institute of Energy Research, Systems Analysis and Technology Evaluation (IEF-STE, Germany)
WP2: Comparative study of CCS communication methods	Leiden University (The Netherlands) & University of Cambridge (The United Kingdom)
WP3: Representative surveys of public awareness, knowledge and opinions concerning CCS	Stiftelsen SINTEF (Norway), Wuppertal Institute for Climate, Environment and Energy (Germany) & University of Cambridge (The United Kingdom)
WP4: Development of recommendations for CCS communication and dissemination activities	Centre for Research and Technology Hellas/Institute for Solid Fuels Technology and Application (CERTH/ISFTA, Greece) & National Institute of Marine Geology and Geoecology (GeoEcoMar, Romania)

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In the following, the main activities and the main results of the four work packages (WP) are described. However, the results are not explained in detail, because they are documented in the deliverables of the project. Thus, the description of the activities of the work packages includes a reference to the deliverable with the respective results in detail.

## WP1: Coordination and Management

The main activities of the “Coordination and Management” (WP1) during the project period were to initiate and to support the effective cooperation between the partners as well as to ensure the implementation of the work plan and to improve the process when it was necessary. In the framework of each work package, the activities were coordinated by the work package leaders (WPL, cf. Table 2). To ensure that the research methods were applied in a similar manner in all participating countries, the research activities in each work package were prepared by the WPL in close cooperation with the coordinator.

A further focus of the coordination and management activities was directed on the preparation and organisation of the project meetings. During the project period four meetings were carried out, each of them focussing on the development and discussion of the materials and instruments which were necessary for the implementation of the work packages (cf. Table 3).

**Table 3: Meetings of the project “Impact of Communication”**

Meeting	Date	Location	Focus of the discussions
Kick-off meeting	January 20-21, 2009	Juelich, Germany	<ul style="list-style-type: none"> <li>▪ Basic principles concerning the cooperation</li> <li>▪ Consortium Agreement</li> <li>▪ First steps of the project implementation</li> </ul>
1 <sup>st</sup> mid-term meeting	April 27-28, 2009	Bucharest, Romania	<ul style="list-style-type: none"> <li>▪ Development of the necessary materials and instruments for the WP2 and WP3 implementation</li> <li>▪ Time schedule for the implementation of WP2 and WP3 for each country</li> </ul>
2 <sup>nd</sup> mid-term meeting	August 25-26, 2009	Trondheim, Norway	<ul style="list-style-type: none"> <li>▪ Plan for the analysis of the WP2 data on the national and cross-national level</li> <li>▪ Finalisation of the questionnaires for the national and regional surveys (WP3)</li> <li>▪ Finalisation of a structural equation model for the analysis of the WP3 data</li> </ul>

Meeting	Date	Location	Focus of the discussions
End-of-term meeting	November 30- December 1, 2008	Thessaloniki, Greece	<ul style="list-style-type: none"> <li>▪ Presentation of the national and cross-national analyses of the WP2 results</li> <li>▪ Relevance of the WP2 results with regard to recommendations for CCS communication</li> <li>▪ Plan for the analysis of the survey data (WP3) on the regional, national and cross-national level</li> <li>▪ Procedures and timetables for the development of recommendations for CCS communication and for the dissemination of the project results</li> </ul>

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The meetings which took place in Romania, Norway and Greece were prepared and organised by the coordinator in close cooperation with the national partners who hosted the meeting. The meeting in Romania was hosted by the National Institute of Marine Geology and Geoecology (GeoEcoMar) and the Institute for Studies and Power Engineering (ISPE), in Norway it was hosted by SINTEF and the meeting in Greece was hosted by the Centre for Research and Technology Hellas/Institute for Solid Fuels Technology and Application (CERTH/ISFTA) and the University of Macedonia, Economic and Social Sciences Department of Applied Informatics. In addition to the project meetings, the information flow and communication between the partners were supported by emails, the Google Group “Impact of communication” and teleconferences.

## **WP2: Comparative study of CCS communication methods**

The main objective of the “Comparative study of CCS communication methods” (WP2) in the framework of the the project “Impact of communication” was to compare two different approaches of CCS communication – focus group discussions (FGD) and Information-Choice Questionnaires (ICQ) – with regard to their effectiveness. However, the comparison of two communication methods with different characteristics required that the basic conditions under which their implementation takes place be controlled in order to keep non-intended influences on the results to a minimum. Furthermore, in order to ensure that the results of the comparative studies of the six countries involved in the project can be compared, it was necessary to define basic principles of the methodological design and to develop materials and instruments which were used in all countries in the same manner.

## **Methodological design of the comparative study of CCS communication methods**

An important principle of the methodological design of the comparative study of CCS communication methods was the establishment of three focus groups in each of the six participating countries. Except for the UK, these focus groups consisted of ten participants per group who were lay persons regarding CCS. In the UK, two focus groups consisting of twelve persons and one focus group consisting of ten persons were run. These figures amount to a total focus group sample of 184 participants.

Each focus group met only once and in order to ensure that the meetings strictly followed the same course, the Leiden University team developed moderator and expert scripts which were similar for each county, but also contained country-specific adaptations (D 2.1 and D 2.2; cf. Table 4). In order to measure the knowledge and attitudes of the focus group participants concerning CCS, the Leiden University team developed a computer-aided questionnaire, which was filled out by the participants subsequent to the focus group meetings (D 2.3; cf. Table 4).

Another important precondition for the comparison of FGD and ICQ was to ensure an identical composition of focus groups and ICQ groups. Therefore, the most important rule concerning group composition was that focus group and ICQ participants should be matched. "Matching" means that for each participant of a focus group, a person with similar individual characteristics has to be recruited for participation in the ICQ survey. For example, if a male, older than 55 years with the occupation "locksmith" participated in one of the focus groups, it was necessary to have a male, older than 55 years with the occupation "locksmith", as a participant in the ICQ survey.

ICQ and focus group participants were matched on the basis of gender, age, level of education, and occupation. In particular, it was ensured that each focus group participant was paired to an ICQ participant who had identical education and belonged to a comparable occupational group. Furthermore, it was ensured that each focus group participant had the same gender as his or her matched ICQ participant, and belonged to an identical age group. An additional criterion was that ICQ participants had to be unacquainted with focus group participants. These matching criteria were strictly followed by each of the participating countries, and the matching was very successful. Thus, in each of the six participating countries, the number of ICQ participants was the same as the number of focus groups were conducted (which amounts to a total sample of 184 ICQ participants).

The ICQ was similar for all countries, but also contained country-specific adaptations (D 2.4, cf. Table 4). The ICQ was developed by the Leiden University team and programmed by using the software "LimeSurvey" (cf. <http://www.limesurvey.org/>). The computer-aided questionnaire for the focus group participants was also programmed with "LimeSurvey".

All materials for the implementation of the comparative study – moderator and expert script, questionnaire for the focus groups participants and Information-Choice Questionnaire – were developed in English and had to be translated by the national research teams into their respective native language.

The detailed descriptions of the principles applied in the methodological design and the implementations of the comparative studies of communication methods in general and specific to the participating countries can be found in the national reports (D 2.6a-D 2.6f, cf. Table 4) and in the report on the cross-national analyses of the results of the comparative study (D 2.7, cf. Table 4).

### **Conclusions based on the results of the national comparative studies of CCS communication methods**

The results of the comparative studies of CCS communication methods for each of the six countries are explained in detail in the national reports (D 2.6a-D 2.6f, cf. Table 4). In this regard, it should be stressed that due to the small sample sizes, the comparison of FGD and ICQ in terms of opinion quality in the scope of one country was not meaningful. Therefore, the national reports do not cover comparisons between FGD and ICQ with regard to the measurements of opinion quality. For the meaningful comparisons of FGD and ICQ as well as the conclusions about the effectiveness of these methods, cross-national analyses of the results of the national comparative studies were carried out (D 2.7, cf. Table 4).

Thus, in the national reports, the results of the comparative studies in the respective countries are described in terms of people's overall opinions towards two CCS options, their evaluations of specific attributes of each of these CCS options, their evaluations of the information they received (and for FGD, also their evaluations of the expert presenting the information), and their recalling of information presented in the focus groups and ICQ. In the next sections, for summing up the results of the national studies the conclusions of each national report are presented.

#### *Conclusions of the comparative study of CCS communication methods in Germany [Schumann & Pietzner, 2009] (D 2.6a)*

In the German study, focus group and ICQ participants received identical information about the following two options for the implementation of CCS: "Cluster of four coal-fired power plants with CO<sub>2</sub> capture and storage" (in the national report referred to as "Technology 1") and "One power plant using coal gasification with CO<sub>2</sub> capture and storage" (in the national report referred to as "Technology 2").

The results of the analyses showed that on average, the FGD and ICQ participants perceived the information provided to be of high quality, i.e. they considered it to be unbiased, not one-sided, comprehensible, valid, new and useful. The expert who

presented the information during the focus group meetings was perceived by the participants as a genuine energy expert who was honest and reliable.

With regard to their ability to form an opinion on the two CCS options, the participants of both groups reported that it was not difficult to form an opinion, that they had sufficient information and that they felt able to form an accurate impression of what the technologies entail. Accordingly, on the one hand, the results of the knowledge test illustrate that on average a considerable amount of the information was correctly recalled by the participants. On the other hand, the results of the knowledge test reveal several misconceptions that are widely shared amongst the participants. Furthermore, results of the knowledge test suggest that the information processing was somewhat better amongst ICQ participants than amongst the FGD participants.

With regard to the opinions on the two CCS options, the results indicate that FGD participants did not prefer one option over the other, whereas ICQ participants had a clear preference for Technology 2 over Technology 1. However, both groups appreciated the fact that both technologies would lead to a decrease of CO<sub>2</sub> emissions in Germany. Furthermore, they appreciated that Technology 2 would produce hydrogen as a by-product which could be used for several purposes.

The main concerns amongst FGD and ICQ participants regarding the CCS options were that they would lead to an increase in the energy price, that the storage of CO<sub>2</sub> could possibly displace useful underground water supplies or contaminate useful water, and that in case of Technology 1 most of the coal needed would be imported from other countries. In their own explanations of their overall opinions the participants mainly expressed concerns with regard to the uncertainty, high risks and high costs of the technologies. They also expressed the opinion that CCS would not be “a solution to the climate change problem” and that it would be “better to invest more in renewable energies”.

Concerning the stability and consistency of the participants' opinions, several results of the German study suggest that the opinions of the ICQ participants are more stable and consistent than the opinions of the FGD participants. However, as explained above, it is difficult to generalize the effectiveness of the two communication methods in terms of opinion quality on the basis of the German data due to the small sample sizes. Such conclusions were drawn on the basis of cross-national comparisons of the data sets of all participating countries (D 2. 7).

*Conclusions of the comparative study of CCS communication methods in Greece [Markos et al., 2009] (D 2.6b)*

In the Greek study, focus group and ICQ participants received identical information about the following two options for the implementation of CCS: “Cluster of four coal-fired power plants with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 1”) and “One gas turbine power plant with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 2”).

The results showed appreciation for the information that participants had received: both focus group and ICQ participants considered the general information about CCS and the two selected CCS technologies to be of high quality. Also, focus group participants considered the expert who had provided the information in the focus groups highly reliable. Further, focus group and ICQ participants recalled a considerable amount of the information provided.

With regard to the opinions about Technology 1 and Technology 2, results showed that participants were not very enthusiastic about the two technologies, but participants did not consider the technologies very problematic either. In the ICQ, Technology 2 was somewhat preferred over Technology 1. What participants appreciated about both technologies was that they would both lead to a decrease in CO<sub>2</sub> emissions in Greece. Participants also liked that Greece would rely on local coal sources, by implementing Technology 1 and were positive towards the construction of a gas turbine power plant in the country, by implementing Technology 2.

Main concerns about the two technologies referred to the fact that both technologies would have high implementation costs, mainly due to the lack of infrastructure and know-how in Greece. Participants were also worried about their quality of drinking water, pollution due to coal mining, and to miners’ safety and about safety of CO<sub>2</sub> transport in onshore pipelines. As far as Technology 2 is concerned, they also expressed their scepticism regarding the dependence of Greece on foreign natural gas. Finally, participants’ own explanations of their opinions about the technologies also indicated concern about the safety and, in particular, the risks associated with CO<sub>2</sub> leakage.

*Conclusions of the comparative study of CCS communication methods in Norway [Næss et al., 2010] (D 2.6c)*

In the Norwegian study, focus group and ICQ participants received identical information about the following two options for the implementation of CCS: “Cluster of four gas-fired power plants with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 1”) and “One gas turbine power plant with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 2”)

With regard to the overall opinions of the two technologies the FDG participants were overall negative to both technologies scores on the average below 4 on a scale from 1 (=very bad) to 7 (=very good), while the ICQ respondents were positive scoring on the average 4.9 and 5.1 respectively on the same scale. However, the participants did not consider the technology very problematic either, and in a referendum they might not have vetoed any of the technologies. It should be noted that while Technology 2 got the best evaluation the respondents were evenly split when asked to choose between them. The respondents further felt that while they had been informed and were able to form an opinion this opinion was not cast in stone. Both sets could change their minds.

In their evaluation of the two technologies the participants saw it as a great advantage that both technologies would reduce CO<sub>2</sub> emissions in Norway. However, there were several concerns about safety of pipelines and storage or price.

With regard to the knowledge test, both sets of participants scored an average of 10 correct answers out 15 test questions. A person answering totally at random answer would get 3.75 correct answers. It shows that both sets managed to process information, however, the level of the knowledge before the tests is not known.

Finally, it should be mentioned that both sets of participants appreciated the opportunity to voice their opinion on a rather large and technical question, and although they felt some restrictions in making their choices while answering the questionnaire, they did not feel overly restricted.

*Conclusions of the comparative study of CCS communication methods in Romania [Cismaru et al., 2010] (D 2.6d)*

In the Romanian study, focus group and ICQ participants received identical information about the following two options for the implementation of CCS: “Cluster of four coal-fired power plants with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 1”) and “One gas turbine power plant with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 2”).

The results showed appreciation for the information that participants had received: both focus group and ICQ participants considered the information about CCS and the two selected CCS options to be comprehensible, valid and useful. Also, focus group

participants considered the expert who had provided the information in the focus groups highly reliable. Further, focus group and ICQ participants recalled a considerable amount of the information provided.

With regard to the opinions about Technology 1 and Technology 2, results showed that participants were very positive about the two technologies, they would even vote for their implementation in a national referendum. There was no difference between the acceptances of the two technologies. As for the level of acceptance of the two technologies, focus group participants were more positive in comparison with the ICQ participants as a result of the perceived legitimacy of the expert and of the face-to-face- mode of interaction.

*Conclusions of the comparative study of CCS communication methods in the Netherlands [Ter Mors et al., 2009] (D 2.6e)*

In the Dutch study, focus group and ICQ participants received identical information about the following two options for the implementation of CCS: “Cluster of four coal-fired power plants with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 1”) and “One power plant using coal gasification with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 2”).

The results showed appreciation for the information that participants had received: both focus group and ICQ participants considered the general information about CCS and the two selected CCS technologies to be of high quality. Also, focus group participants considered the expert who had provided the information in the focus groups highly reliable. Further, focus group and ICQ participants recalled a considerable amount of the information provided.

With regard to the opinions about the two technologies, Technology 2 was somewhat preferred over Technology 1. What participants appreciated about both technologies was that the technologies would lead to a decrease in CO<sub>2</sub> emissions in the Netherlands. Participants also liked that Technology 2 would produce hydrogen as a by-product.

Main concerns about the two technologies were imbedded in the fact that the technologies would require the use of foreign coal; participants worried about miners' safety in foreign countries, about the contribution of coal mining to pollution of the environment in those countries, and about the consequences of the use of foreign coal for the reliability of the energy supply. Participants' own explanations of their opinions about the technologies also indicated concern about the safety of Technology 1 and 2; participants primarily reported concern about the safety of CO<sub>2</sub> storage. All in all, the results showed that participants were not very enthusiastic about the two technologies, but they did not consider the technologies very problematic either.

*Conclusions of the comparative study of CCS communication methods in the United Kingdom [Reiner et al., 2010b] (D 2.6f)*

In UK study, focus group and ICQ participants received identical information about the following two options for the implementation of CCS: “Cluster of four coal-fired power plants with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 1”) and “One gas-fired power plant with CO<sub>2</sub> capture and storage” (in the national report referred to as “Technology 2”).

The results showed that overall UK participant opinions were more favourable towards Technology 1 (mean 4.57 on a scale from 1=very bad to 7=very good) than Technology 2 (mean 4.21 on a scale from 1=very bad to 7=very good). Participants were most enthusiastic about the contribution Technology 1 made to the greenhouse effect, and rated that the high price of the technology was the greatest drawback. The issue of miner safety was also frequently raised as problematic. When evaluating Technology 2, a similar ranking of advantages and disadvantages was produced. Participants were again opposed to the high price of the technology, and expressed positivity towards its contribution to the greenhouse effect, however this was not on as large a scale as the contribution to the greenhouse effect that was possible using Technology 1. Many UK participants were also positive towards the new installations that would be required for implementation of Technology 2. Overall, most participants were relatively positive about the both technologies and 75% expressed that neither technology was unacceptable.

When participants were given the opportunity to express their feelings about Technology 1, the majority of participants indicated that they worried more about the risks of this technology in terms of leakage and ecological implications, transport safety, and long pipelines, as well as low working standards and miner safety issues. Participants were very enthusiastic towards its environmental benefits. With regard to Technology 2, participants tended to find its high costs a greater concern than leakage risks.

In terms of information quality, overall participants rated the information as being unbiased, not one-sided, comprehensible, valid, new and useful. The majority of UK participants (60.3%) were also grateful that they were given the opportunity to express their opinion about the two technologies. The data shows that the UK participants felt slightly restricted in their choice between the two technologies. The participants were also not in favour of expressing their views in other ways, for example displaying posters and wearing badges in support of the cause. The UK participants scored an average of 60% in the knowledge test, which is quite good given the technical nature of the issues presented.

### **Main findings and conclusion of the cross-national analysis of the comparative studies of CCS communication methods [Terwel et al., 2009] (D 2.7)**

The aim of the cross-national study was to test which communication method – FGD versus ICQ – yields the highest quality opinions. To answer this question, both focus groups and ICQs have been conducted in each of the participating countries. Focus group members and ICQ participants received identical information about CCS in general and about two specific CCS options. They were subsequently asked to state their overall opinion about each of these CCS options. The quality of their opinions was determined by looking at opinion consistency, opinion stability, and opinion confidence. Several other measures were included as control variables, among which information transfer and perceived information quality.

Important to note, the type of communication examined in the comparative study was informative in nature. Informative communication in the context of CCS involves providing the public with factual, even-handed information about CCS and its potential benefits and risks. Such information lets the established facts speak for themselves and allows people to reach their own conclusions about CCS on the basis of the information provided. Thus, the comparative study does not pertain to persuasive communications that aim to induce public acceptance of CCS.

The results for the three indicators of opinion quality – opinion consistency, opinion stability, and opinion confidence – convincingly demonstrated that opinion quality was higher after completing an ICQ than after participating in a focus group discussion. Hence, the cross-national study strongly indicates that the ICQ seems the more effective communication method of the two when it comes to communication about CCS, as it leads to higher quality opinions. A plausible explanation for this finding is that people are better capable of integrating pieces of information when these are provided in an ICQ than during expert presentations in focus group session.

That is, information integration in focus groups may well be rather poor due to intragroup processes such as group think in which independent thinking is lost and people try to minimize conflict and reach consensus without critically testing, analyzing, and evaluating the information provided. Indeed, we did find some statistical evidence that such processes have actually played a role because we observed that focus group participants varied substantially less in their overall opinions toward the two technologies than ICQ participants. This seems to indicate more differentiation in overall opinions in the ICQ condition compared to the focus group condition. In other words, ICQ participants seem to have reported their personal opinions while the opinions reported in the focus groups were affected by group processes such as group think and at least to some extent may be considered “group” opinions. This shows

that even in a well managed focus group 'negative' group effects cannot entirely be avoided.

Further, significant differences between focus group participants and ICQ respondents on any of the control measures were not found. That is, information transfer was equally successful and the perceived quality of the information was identical between experimental conditions as well. Moreover, across countries, the expert was perceived as highly credible. Accordingly, the results on the control variables rule out possible alternative explanations for the difference in opinion quality between focus group discussions and ICQs.

While ICQs have been found more effective in terms of opinion quality than focus group discussions, this is not to say that focus groups perform poor in this regard. In fact, the focus group meetings as arranged for the current study resulted in rather high quality opinions. Part of the reason why focus groups did rather well may have had to do with the way in which the meetings were arranged. First, the information presented by the expert was developed by social scientists and technical experts in a joint effort. In doing so, it was ensured that it was even-handed and comprehensible for laypeople, which has probably contributed to the effectiveness of the focus group discussions. Moreover, because it was taken great care in developing the expert information to be presented and selecting the experts, it was possible to avoid potential problems such as that people would distrust the expert, that they would consider the expert to be biased (e.g., perceive the expert as a clear CCS proponent), or that the expert would fail to accurately explain in laypeople language what CCS is.

Similarly, by developing moderator guidelines and paying attention to group composition, it was avoided distracting group processes such as one person dominating the group discussions, or discussions going completely off-topic. The current research shows that if these conditions are met, focus group discussions can be relatively effective in terms of opinion quality. A suggestion for future research would be to examine whether focus group discussions may be improved by including some features of the ICQ into the discussions (in particular the aspects that reduce group processes and that enhance information processing and integration, such as introducing a personal quiz during the expert presentations).

Also important to note, regardless of the type of method (ICQ or focus group discussions), the study shows that it is possible to inform people on a complex issue as CCS in such a way that public opinions that eventually result from information about CCS are indeed of high quality. One of the preconditions for this situation to occur is that good quality information is provided: information that is relevant, comprehensible, balanced, and valid. This study shows that if this precondition is met, people are able to reach high-quality opinions and they are satisfied with the quality of the information provided.

To sum up, on the basis of the cross-national study it was concluded that the ICQ seems to be a more effective communication method than focus group discussions when it comes to communication about Carbon dioxide Capture and Storage (CCS), as it leads to higher quality opinions which are more consistent, more stable and that people are more confident about.

### **WP3: Representative surveys of public awareness, knowledge and opinions concerning CCS**

Within the project “Impact of communication” a “representative survey of public awareness, knowledge and opinions concerning CCS” (WP3) was carried out in every participating countries. These representative surveys were conducted on a national level only in Romania and Greece, whereas the national surveys in Germany, Norway, the Netherlands and the UK were supplemented by simultaneous regional surveys.

The main aim of the national surveys was to scrutinise the public awareness, knowledge and opinions concerning CCS in the context of more general attitudes towards climate change and other energy technologies. The particular goal of the regional surveys was to test the reaction of respondents to existing proposals for the capture, transport and storage of CO<sub>2</sub> from a power plant in their region and to contrast national attitudes in response to the specific proposal and other issues with those found in the regions.

To ensure comparability between all countries, two questionnaires were developed by the WP3 leaders: a questionnaire for the national surveys which contains a set of core questions which were used in all countries (D 3.1, cf. Table 4). For the countries with planned or ongoing CCS projects like Germany, the Netherlands, Norway and the UK an extended version of the questionnaire was developed including questions regarding the awareness and attitudes on specific demo plants on a regional level (D 3.2, cf. Table 4). Both questionnaires were developed in English and the translation in each language was carried out very accurately with all partners taking care of country specific terms and methodological requirements.

To ensure representativeness, national surveys consisted of at least 1.000 respondents, cf. [Pietzner et al., 2010]. Participants were recruited by professional polling firms commissioned by each of the national partners. The Dutch, British and Norwegian surveys were internet surveys drawn from large existing national panels of respondents whereas the German survey was conducted by telephone. All surveys were representative of the national population for the national sample and representative of the region for the regional sample although the regional samples are smaller and thus have larger standard errors. The representativeness was based on several

criteria, such as gender, age, region and for some countries vocational or educational qualification or class.

In each region of interest a regional “booster” survey was conducted to increase the number of regional respondents to supplement those included in the national sample. Thus, the number of respondents in the regional samples range from the minimum of 353 to the maximum of 625, cf. [Reiner et al., 2010a]. Surveys were conducted from October 2009 to January 2010.

The analysis and comparison of the results of the six national and four regional surveys are described in detail in the cross-national report [Pietzner et al., 2010] (D 3.3, cf. Table 4) and in the cross-regional report [Reiner et al., 2010a] (D 3.4, cf. Table 4). Therefore, to sum up the results in this report, only the conclusions of the cross-national and cross-regional reports are presented.

### **Conclusions of the analysis and comparison of the results of the national surveys of public awareness, knowledge and opinions concerning CCS [Pietzner et al., 2010] (D 3.3)**

It was known at the outset of the project that public awareness of CCS was likely to be low and opinions would be unstable and largely uninformed on the topic and technology of CCS. The results of the six surveys does not contradict that basic assessment, but it does provide some insights into the situations facing policy and decision makers in the six participating countries – Greece, Germany, the Netherlands, Norway, Romania and the UK. It should be stressed at this point that the survey and data presented in the cross-national report are not in any way representative of Europe or the EU as a whole, the report merely describes the situation in these six quite different countries. Further, in the cross-national report it is shown that there are large national variations, and we can in no way extrapolate the findings even to neighbouring countries like Bulgaria, France or Sweden where one would expect the situation to be quite different. In order to better understand the situation in countries outside of our sample, separate investigations must be conducted although such studies would benefit from using a similar survey instrument that would allow comparison with our results.

Within these limitations however, the surveys offer interesting some insights into the current public opinion on CCS. In the cross-national report we have discussed the results in detail, and in the appendix we present the distribution of all items in the questionnaire. Hence this conclusion will be brief and focus on the most salient points identified: Attitudes towards environment and sources of electricity, Trust, Knowledge, Awareness of CCS, Initial attitudes towards CCS and results of the experiment. The risk and benefit analysis of specific capture, transport and storage proposals will not be discussed here, nor do we address regional effects both of

which are addressed in a companion report [Reiner et al., 2010]. In this conclusion we will not investigate means, correlations, regressions etc. between the various variables, but having discussed the abovementioned topics in a national context we will discuss socio-demographics and CCS.

**Attitudes:** the relative importance of environmental issues

Employing methods from the EUROBAROMETER the respondents rated the relative importance of five topics in their respective countries on a 7 point scale (1=least important to 7=most important). The five topics were Unemployment, Health care system, Crime, the Economic situation and the Environment. The six countries as a whole viewed the Economic situation and the Health care system as the most important; however there were large national variations. In Greece, Environment was the most important of these five issues, Romania and Germany ranked Environment as the third most important issue, while in the Netherlands and Norway Environment ranked at or near the bottom of the five issues. The only safe conclusion to be made at this point is that even though it is considered important, Environment is not a clear winner in the fight for attention amongst other key national priorities.

**Attitudes:** use of different technologies for electrical power

The respondents rated seven potential sources of electrical power on a scale from 1 (=strongly opposed) to 7 (=strongly support). In all six countries the rank of the three preferred technologies was: (1) Solar, (2) Wind and (3) Hydroelectric. The two first consistently had mean scores above 6, Hydroelectric had about 6. Biomass and Natural gas had positive support on average, both well above 4, while Coal and Nuclear energy were opposed by the majority of respondents although there were important national variations, for example, over 40% favoured the use of coal in Romania and almost 50% favoured the use of nuclear power in the UK, both of which were significantly stronger support for coal and nuclear respectively than in any other country surveyed.

### **Media preference**

The respondents were asked to rate the likelihood of their use of different media channels to obtain information about new energy technologies on a scale from 1 (=unlikely) to 7 (=likely). The media channels were: Newspapers, Magazines, Scientific or specialist press, Television (TV), Radio, Internet sites of major media outlets and Blogs/wikis. Apart from the preference for TV there were considerable variations between the nations. In the Netherlands and the UK Internet sites of major media outlets were ranked as number two, in Norway, Greece and Germany it was the Newspapers, in Romania it was the Radio. Blogs were rated as unlikely sources of information in the Netherlands, the UK and Norway but were more important in Germany, Greece and Romania. Specialist papers, Magazines and Newspapers all saw

respectable use. In such a situation, with no clear patterns of media preference it would seem that the only solution to spread information would be to employ a broad variety of media, and tailor the actual use to each country's specific situation.

### **Trust**

First of all, Scientists were by far the most trustworthy group on information about energy-related issues in all countries followed by Environmental protection organisations. The third highest ranked institution was Consumer protection organisations. Perhaps somewhat surprisingly, information from Electricity and gas companies was viewed as neither trusted nor mistrusted on average as was information from the European Union. However, trust in the European Union as a source of information was much greater in Romania and Greece than in the other four countries. Journalists, Regional governments, National governments and especially Political parties, were to a varying degree distrusted in all countries. Thus in order to more credibly inform the public it is necessary for governments to involve scientists as well as Environmental Protection Organisations and Consumer organisations.

### **Knowledge issues**

There were four sets of questions associated with knowledge issues: (i) General Knowledge on environmental issues and science, (ii) Knowledge on activities contributing to CO<sub>2</sub> build-up, (iii) Awareness of CCS and (iv) understanding of which environmental issue CCS is meant to address. A detailed presentation of the data is provided in the appendix of the cross-national report. Awareness and knowledge of CCS' impact on environmental concerns will be discussed separately below.

Regarding the knowledge questions in general the majority of the respondents were able to answer correctly a series of six questions on general issues. The most problematic question was about the causes for the greenhouse effect. More than half of respondents believed that global warming is caused by a hole in the atmosphere. Regarding knowledge on activities contributing to CO<sub>2</sub> build-up in the atmosphere on 5 of the 6 questions roughly 9 out of 10 respondents gave the correct answer. The sixth and problematic question was the role of nuclear power, where 44% of the respondents answered that nuclear power stations increased CO<sub>2</sub> levels.

### **Awareness of CCS and its impact on environmental concerns**

In the six countries taken as a whole, CCS is relatively little known, 60% of the respondents had never heard of it, 32% had heard "a little bit" and 8% had heard "quite a bit". There is much variation between the nations, in Romania 76% had not heard about CCS while in Norway only 38% had not heard of it. However, apart from Norway and the Netherlands (48%) the majority of the populations had not heard of CCS. The respondents were also asked whether or not CCS could contribute to re-

duce the following six environmental concerns: Toxic waste, Ozone depletion, Global warming, Acid rain, Smog and Water pollution. CCS is designed only to reduce Global warming, however, there were typically between 30 and 50% incorrect answers for each question. This of course is consistent with the limited awareness of CCS in most countries. Thus the general public is clearly uninformed about CCS and its consequences, even though there are important national variations in awareness and knowledge.

### **Initial attitudes** towards CCS demonstration plants

Even though the respondents had relatively little knowledge on CCS and its impacts they had opinions on a CCS demonstration plants. The overall attitude in the six countries was supportive, 53% supported it (answered 5 to 7 on the 1-7 scale from 1=strongly opposed to 7=strongly supportive), 26% were neutral and 21% opposed it (answered 1 to 3 on the scale). However, the support was, by far, strongest in Greece and Romania. In these two countries almost three-quarters of respondents supported a demonstration plant. In the other four countries support ranged from 38% (Norway) to 46% (the Netherlands). Thus in the four countries in the North Sea area, countries with concrete plans for demonstration plants, support is only lukewarm.

### **Information experiment results**

As mentioned earlier, initial attitudes regarding CCS can be expected to be highly unstable, because they are reported by people who have very little knowledge about the technology. Due to that instability, future communications on CCS are likely to heavily influence the initial attitudes people hold. The impact of CCS-communication on initial attitudes is exactly what we examined by means of an experiment which was included in the representative surveys. More specifically, we examined whether the presentation of positive or negative information about CCS would change initial attitudes. Our prediction was that initial attitudes regarding CCS would become more negative when a short negative text about CCS is presented, whereas a short positive text would lead to more positive attitudes. In order to examine this effect, after respondents had indicated their initial attitudes regarding CCS they were randomly assigned to one of two experimental conditions: respectively half of the respondents in each country received negative or positive information about CCS. The details of the experiment and the results are presented in the cross-national report.

To summarise, the results of the experiment, firstly confirm the expectation that initial attitudes of lay persons who are not thoroughly informed on CCS are highly unstable. Secondly, the assumption has been confirmed that initial attitudes of lay persons change in a negative direction after presenting negative information to them and in a positive direction after positive information is presented to them. Thirdly, regarding

the influence of the information source, the results on the overall average for the respondents of all countries indicate that the source of information has virtually no impact on the change of attitude. Only in Greece and Germany did we find information source to have an impact. That is, in Germany negative CCS information had more impact when the identity of the source was unknown compared to when Greenpeace was said to have provided the information. In Greece, having Shell as an information source of positive CCS information led to somewhat more communication-congruent attitude change compared to when respondents had not received any information on the identity of the information source.

### **Socio-demographics**

A thorough analysis of how the socio-demographic status affects the other variables is far too space-consuming to be included here. However, we will look briefly on the effects of socio-demographics on two key items: Awareness of CCS and Initial attitude of CCS demonstration plant. For detailed results please consult the cross-national report.

Regarding knowledge of CCS there is a very striking difference between the sexes. In all six countries women consistently had less knowledge of CCS than men. The difference in percentage terms between men and woman ranged from 7% (Greece) to 33% (UK) more women than men claim to not have heard about CCS. Looking at age and awareness of CCS we do not find patterns as strong as these, however in both Norway and the Netherlands there is an increase in knowledge of CCS corresponding to an increase in age. Regarding educational level we again find a clear picture: higher education means greater likelihood of having heard about CCS. This holds true for all countries except Romania. Regarding initial attitudes towards a CCS demonstration plant we find that women are more negative towards CCS in all countries except Greece although this difference is sometimes slight. Further, for the Netherlands and Germany we find that older people are more positive towards CCS than younger people; and finally that in the Netherlands, the UK and Norway the more educated are more likely to support CCS than the less educated.

The results are not entirely surprising. However they are still important, and the gender difference is probably the most important of all. Thus policy makers who want to communicate with the general population need to remember that the general population consists of different subgroups. Communication strategies must be tailored to the relevant group.

### **Some final conclusions**

In addition to presenting actual figures on several issues like knowledge, attitudes, trust, awareness of CCS and attitudes towards CCS, the survey confirmed several of our assumptions about public perceptions of CCS: It is unstable, uninformed on im-

portant issues, there are differences based on nationality, age, gender, education level and so on. In order to inform the general public one must not rely on one single information strategy. Rather one should target different groups and develop communication strategies suitable for each group.

However we would like to stress that our research and conclusions are not in any way final. In such an unstable field where there is still so much to research, it cannot be. The value of a first survey is always less than the value of a second, when we can establish a framework for comparison. Thus this research must be seen as a baseline, a starting point for repeated investigation, not a final verdict on the awareness of and attitudes towards CCS in these countries or other European countries.

### **Conclusions of the analysis and comparison of the results of the regional surveys of public awareness, knowledge and opinions concerning CCS [Reiner et al., 2010a] (D 3.4)**

There are several important findings that emerge from the regional surveys and comparing the results of the regional surveys with those of surveys at the national level. Before describing any findings, it is important that there are some important limitations. First, CCS, as seen from the questions on awareness, is still very much a novel concept for most respondents and therefore the initial assessments may not be especially predictive of future assessments as the technology becomes more familiar. Second, although we are looking for differences between regional attitudes where a specific proposal is described and those of respondents in the rest of the country, there are few real projects and so the proposals described are less immediate and thus less likely to provoke strong responses compared to if the projects described were imminent and tangible. Nevertheless, there are some important conclusions that appear fairly robust.

#### **National-level differences are usually more important than within-nation differences**

Although there are some notable differences between regional respondents and those in the rest of the country when we explore the results in greater detail, the simplest explanation for difference is usually differences across nations themselves. Thus, Schleswig-Holstein may be especially negative towards CCS proposals, but Germans overall are already less positive than those in Norway, for example.

#### **Initial attitudes towards CCS correlates with support for specific CCS proposals**

The assessment of the specific CCS proposals does relate to other initial attitudes towards energy technologies, for example, greater support for nuclear power is related to support for the specific proposals, but the best predictor of the level of support (or opposition) to the three specific capture, transport and storage proposals is

the initial support for CCS. Germany was unusual insofar as their initial assessments of CCS (but not the CCS pilot) were quite negative.

### **Need to examine both risks and benefits**

By only comparing risks, one would assume that Norwegian respondents are much less concerned about the risks of CCS and hence likely to be much more supportive towards the proposals than elsewhere, particularly those in Germany, but only focusing on risks would be misleading. Norwegians also perceive the benefits from the proposed project to be much lower than other respondents and hence the overall assessments of most proposals are virtually identical across countries and almost exactly equal to 4.0 on a 7 point scale (1=very little risk or benefit to 7=very much risk or benefit) or neutral.

### **Concerns over personal risks (and benefits) do not appear notably more important than social risks (or benefits)**

Although the assessment of personal risks and benefits is slightly and consistently higher overall, that difference is actually quite small. More importantly, that difference does not vary notably whether respondents were from the region where a proposal was to be sited or whether respondents in the rest of the country, i.e., proximity does not appear to have much impact on whether the risks or benefits are perceived as being personal.

### **Onshore storage (and onshore transport) proposals raise concerns**

The only cases where the overall assessments differ significantly from a neutral assessment are for the case of onshore transport, such as in the UK and Germany and especially towards onshore storage (and in particular in Schleswig-Holstein, which is the region proposed for the onshore storage site in Germany).

## **WP4: Development of recommendations for CCS communication and dissemination activities**

With regard to the dissemination of the project results, CERTH/ISFTA developed the project homepage – <http://www.ccs-communications.gr/> – in cooperation with the IEF-STE (D 4.1, cf. Table 4).

Information about the project was also published on the homepage of FENCO-ERANET ([http://www.fenco-era.net/Impact\\_of\\_Communication](http://www.fenco-era.net/Impact_of_Communication)). Both homepages are linked with the homepage of the IEF-STE (<http://www.fz-juelich.de/ief/ief-ste/index.php?index=255>).

Furthermore, CERTH/ISFTA and GeoEcoMar developed three newsletters in close cooperation with the coordinator (D 4.2, cf. Table 4). These newsletters were published on the project homepage and were sent to relevant contact persons within the

CCS research field. In addition, a description of the project was published in the newsletters of Bellona (Issue 19) and of IEA (Issue 97).

The research approach and results of the project were presented during the Climate Change Congress in Copenhagen (March 2009), the CCT 2009 (May 2009) in Dresden and during the first meeting of IEA GHG Social Research Network in Paris (November 2009).

Up to now two articles about the research approach and results of the project are published [Schumann, 2009, Schumann et al., 2010]. An article for publication in Public Opinion Quarterly is currently in process under the leadership of the Leiden University team. Additionally, the project consortium submitted three abstracts for consideration as papers for the 10th International Conference on Greenhouse Gas Control Technologies (GHGT-10) which will be held on 19-23 September 2010 in Amsterdam.

Relevant for the dissemination of our project approach is also, that the methodological design and procedures of WP2 are replicated in Australia (Peta Ashworth), Japan (Kenshi Itaoka) and USA (Gabrielle Wong-Parodi). This replication is still in progress.

Moreover, the main results of the project "Impact of communication" will be presented during a final workshop which will be held at 20 May 2010 in Amsterdam. This workshop is related to the FENCO ERA-Net Workshop "CCS and Public Engagement" which will be held the day before at the same location. Invited to the final project workshop, which is organised and prepared by CERTH/ISFTA, are relevant experts from the CCS research field as well as political decision-makers and companies.

Beside the dissemination of the project results, WP4 focused on the development of recommendations for CCS communication. In the following, the recommendations which were drawn from the empirical results of WP2 and WP3 are presented.

### **Recommendations for CCS communication [Ziogou et al., 2010] (D 4.3)**

*Recommendations for CCS communication based on the findings of the report on the cross-national comparison within WP2 (Comparative study of CCS communication methods)*

According to the cross-national study [Terwel et al., 2009], the ICQ appears to be a more effective method of communication leading to higher quality opinions. Opinions reported in ICQs are more stable over time, more consistent with evaluations of the specific CCS consequences, and people are more confident about their overall opinions.

The effectiveness of focus group discussions in terms of opinion quality can be achieved through developing information even-handed and comprehensible for lay-people in a joint effort of technical and social experts, selecting skilled moderators, experts well-established in the field of CCS, developing moderator guidelines to keep

the discussion focused and selecting the discussion group in terms of size and composition. The perceived credibility of the expert plays a crucial role in leading to high quality opinions, as without trust in the expert, information provided may be viewed quite sceptically by the participants. Environmental organisations, academic and selected research institutions are considered as the most credible messengers.

However, both methods (ICQ and FGD) can be elements of a CCS communication strategy depending on the scale to be applied (national or regional with actual or planned CCS activities), the aim (education, measure public awareness of CCS, stakeholders engagement etc), the target group (local communities, general public, policymakers, NGO's etc.). Combining quantitative and qualitative methodologies will offer a deeper understanding of the social perception of CCS.

Both communication methods are costly (in terms of human and financial resources), cf. [Ziogou et al., 2010], but the costs associated with the development and deployment of the ICQ can be offset by the greater potential for large-scale applicability of this method.

In countries with actual or planned CCS activities (especially in the case of onshore CO<sub>2</sub> geological storage), there may be the need for real interaction with people living nearby actual CCS activities (for example to identify common misperceptions and understand reactions) so it may be quite useful to conduct a certain number of focus groups at that specific location to promote dialogue and engagement of the local stakeholders. In this case, face-to-face dialogue appears to be an effective way not only to communicate CCS but also to acknowledge the concerns of the local communities addressing the phenomenon known as NIMBY effect (Not in My Back Yard).

In order to reduce 'negative' group effects and enhance information processing and integration within the focus group discussions an option could be to introduce a shorter version of an ICQ within a focus group meeting, this way combining oral and written information. One could for example introduce a personal quiz during the expert presentations to avoid group processes such as group think and to limit the possibility that group rather than individual opinions are reported.

To inform the general population about actual or planned CCS activities or to collect opinions of representative samples of the general public, an Internet version of the ICQ could be easily used without high additional costs compared to the large-scale implementation of focus groups. Along these lines, in countries with long-term CCS plans, informing the general public is more easily done through ICQ's. The design and development of web-based ICQs on CCS is already in progress (in a project funded by the Global CCS Institute).

Provided the need to educate people in order to raise the low level of public awareness about CCS (results of the representative national surveys of public awareness,

knowledge and opinions concerning CCS), specific versions of ICQs about CCS in general could be administered according to the target audiences and be filled in educational institutions or in museums, libraries, science centres and shopping malls.

The development and provision of good quality information about CCS (i.e., information that is relevant, valid, balanced, and comprehensible) enhances the effectiveness of both methods in terms of forming high-quality opinions. In particular for the ICQ method the policy relevant choice problem definition and the given information about the consequences of the selected CCS options should be carried by a differentiated group of social and technical experts and from a range of sources (i.e. industry, government and NGO) in order to avoid the risk of losing its accuracy, balance and credibility. Information developed using a range of experts with diverse viewpoints has a high credibility because of its perceived objectiveness.

*General recommendations for CCS communication based on the findings of the reports on the cross-national and cross-regional comparison within WP3 (representative national and regional surveys of public awareness, knowledge and opinions concerning CCS)*

The recommendations are drawn from the findings of the WP3 reports “Results of the representative national surveys of public awareness, knowledge and opinions concerning CCS” in six participating countries Germany, Greece, the Netherlands, Norway, Romania and the UK [Pietzner et al., 2010] and the “Results of regional surveys of public awareness and opinions regarding CO<sub>2</sub> capture, transport and storage project proposals” in Germany, the Netherlands, Norway and the UK [Reiner et al., 2010a], unless otherwise clearly stated.

### ***Overall level of awareness is low - Need to raise public awareness***

Over 60% of respondents in the six participating countries claim to have never heard of CCS and only 8 % had heard “quite a bit” about the technology. There were important national variations, with over three-quarters of Romanian and Greek respondents never having heard of CCS, but even in Norway, which has longstanding involvement on the subject, almost 40% had never heard of CCS and in all cases, one should expect that these figures are conservative estimates.

### ***Overall support for CCS among the six countries is mixed***

In all six countries the majority of respondents supported the use of CCS as part of a strategy to address global warming than who objected to its use, but in the four countries where there was the greatest awareness of CCS (Norway, UK, the Netherlands and Germany) initial levels of support was below 50%, ranging from 38.5% in Norway to 47.2% in the UK. Larger numbers (over 60%) in Romania and Greece expressed initial support for CCS, but, as noted, fully three-quarters of respondents had never heard of CCS before. Initial levels of support for a CCS demonstration plant were similar or slightly higher ranging from 40.5% in Norway to over 70% in Greece and

Romania. Governments should study their national data in greater detail, but in all cases it is clear that support is generally weak, built on a low base of awareness.

***National differences in current status of levels of awareness indicates a need to tailor communication strategies at the national and regional level***

The level of awareness of CCS varies from less than 25% in Romania and Greece to 60% in Norway amongst the surveys conducted in the six countries. This clearly shows that it is not possible to assume similar levels of awareness in a European context. Instead, strategies for communication must be based on nationally relevant data. Moreover, support for CCS does not automatically rise with greater awareness. As shown in the regional report, support for CCS as part of a strategy to address global warming and for a CCS demonstration rose with greater levels of awareness in Norway, UK and the Netherlands but did not change or even fell slightly in Germany.

***Target specific subpopulations***

While there are national variations as to the strength of differences between subgroups three groups have lower levels of awareness: women, younger people and those without higher education. Given that these groups are often less supportive towards CCS in their initial reaction, information on CCS should be targeted towards these populations, by choice of information channels and content. More research must be conducted on how best to target and engage these subgroups.

***Balanced and valid information***

The project developed balanced, valid and accessible information regarding CCS in WP2. This information functioned well for both Focus groups and ICQ respondents. The dissemination of such information is important to combat existing misconceptions of the implications of CCS, which the surveys found to be widespread.

For information to have an impact on public attitudes, it needs to be concrete enough to be contextually relevant, as the survey showed different levels of acceptance of CCS in general and concrete suggestions for CCS demonstration plants.

***Regional differences***

The WP3 report on regional differences in the four countries with actual CCS projects under development (Germany Netherlands, Norway and UK) provides some evidence, especially in the case of Germany, that regional differences exist regarding the initial attitudes towards CCS. These regional differences regarding the use of energy sources developed over time and will be also relevant for the communication of CCS. This is reflected by the fact that the initial attitudes concerning CCS and the shifts in attitudes related to information provision also differs regionally. Communication of CCS should take such regional differences into account, particularly with re-

gard to the public engagement associated with implementation of demonstration plants within a region.

### ***Onshore transport and storage are seen as posing the greatest risks***

In the regional report, concrete proposals for the capture, transport and storage of CO<sub>2</sub> were provided and the most negative reaction was towards the elements of those proposals involving onshore transport and storage in the regions concerned. Overall support for these projects, which were described in greater detail, show very weak levels of support and potentially strong opposition in certain countries and regions, most notably Schleswig-Holstein in Germany (potential onshore storage site). More generally, focusing only on risks can be misleading since countries such as Norway which cited the risks as being low also viewed the benefits as also being quite low, so that the overall assessments were actually quite similar.

### ***Risks and benefits must be clearly presented in order to enhance knowledge about CCS***

The data on knowledge on the potential of CCS to reduce GHG emissions show that there are some misconceptions about the environmental benefits resulting from the implementation of CCS. Thus it is important to clearly present CCS as a key solution for combating climate change in line with renewable energies and energy efficiency, incorporating also comprehensible information about potential risks associated with the chain of CCS. Since there are large gender differences relative to knowledge and awareness it is necessary to provide information in a form that would be considered relevant and useful.

### ***Communication of CCS is also communication about the use of coal***

A large majority of the public in all six countries surveyed strongly favours the use of renewable energy sources and there is significant opposition to the use of coal and nuclear power. These pre-existing attitudes regarding energy sources are relevant for the communication of CCS since respondents will have far greater familiarity and knowledge of these technologies (although we find that there are persistent misunderstandings about nuclear power producing CO<sub>2</sub> for example). Therefore, communication of CCS should take into account underlying attitudes regarding the use of energy sources which will influence their attitude formation concerning the technologies. With the exception of Norway, where coal is not a part of the energy supply, the link to coal is important and potentially problematic for approval of CCS.

### ***The role of trust***

In all countries surveyed, scientists, followed by environmental protection organisations and consumer organisations were viewed more trustworthy in providing information about energy-related issues than government agencies, journalists and political parties. Thus these three groups should all be engaged in the communication

effort. The experiment of providing positive or negative information with and without the source identified gives some indication that the public is influenced by the information provided though that effect was not much further enhanced nor diminished through knowledge of the source.

### ***Television***

The survey shows that given a choice among standard mass media alternatives, most people in all countries would be most likely to seek information from television. The challenge here is to present the information in a television format that has wider appeal especially to the most important target groups. Alternatives could be strategically placed infomercials or debates with or without documentary elements.

### ***More interactive internet channels should be tried***

Although television was preferred over the Internet as a source for information on energy-related issues, a large share of the public uses the internet as a major source of information and in some countries, such as Germany, even blogs and wikis would be widely used. Given the increasing popularity of such channels especially amongst hard to reach sub-populations, the utilization of such channels should be investigated.

From WP2 we also learned that the ICQ respondents reported that completion of an ICQ was an entertaining way to learn about CCS. Also, there is a large and growing group that extensively consumes applications (or 'apps') via websites such as Facebook or on smartphones. Hence, information provided through some kind of entertaining free game or resource that would be easily disseminated could be an ideal tool to reach target groups: women, youth, and those without higher education.

### ***Further investigations***

This is the first major investigation into this topic in some of the countries surveyed and in no country has there been a sustained or in-depth investigation on the subject of public communications. While we can offer some important insights there are still several important questions that were not addressed in this research, issues that needs to be addressed in order to communicate better with the general population and subgroups within the population or which require a time series to be able to draw any clear conclusions. Also, further investigation into regional variation in awareness and acceptance seems clearly warranted.

Follow-up studies should also be used to identify other knowledge gaps with regard to the whole chain of cause and effect related to CCS (i.e., from the extraction of fossil fuels, via energy production, to the end users in households). Identifying knowledge gaps will be key to deciding on the future education/communication strategies that seek to enable people to reach informed opinions.

### ***Continued monitoring of CCS awareness and attitudes***

As the general debate on CCS continues and as plans for demonstration plants also continue to evolve, so too will general opinions shift and harden. In order to develop the most relevant policies and plans, the levels of awareness and support for CCS should be monitored at regular intervals, which also would enable research into the long term effects of existing and future communication efforts and other CCS developments. The survey data generated in WP3 provide a much needed baseline for investigating such developments.

### ***Investigations of constructions of meaning***

In order to understand sources of opposition to CCS it is necessary to learn more about how people develop their attitudes, which arguments are important and persuasive and how different groups may react differently. This is necessary in order to create information relevant for different subpopulations and test how different forms of information are processed.

### **Deliverables**

In the project, all deliverables described in the proposal were developed (cf. Table 4) with one exception. The deliverable “plan for translating expert information on CCS into ICQ format” was not necessary, because for all countries the same expert scripts were developed with country-specific adaptations (cf. description of WP2 above). The expert information developed for these scripts could be easily transferred to the IQC without the need to write a detailed plan for it.

The deliverables which were shown in Table 4 are provided to the FENCO coordinator by CD-ROM.

**Table 4: Overview of the deliverables of the project “Impact of communication”**

Work package	Deliverables
WP1: Coordination and management	D 1.1 Progress report D 1.2 Final project report
WP2: Comparative study of CCS communication methods	D 2.1 Country-specific expert scripts for the focus group discussions D 2.2 Country-specific moderator scripts for the focus group discussions D 2.3 Country-specific questionnaires for the participants of the focus group discussions D 2.4 Country-specific Information-Choice questionnaires D 2.5 Plans for the analysis of the WP2 data D 2.6a National report on the results of the comparative study of CCS communication methods in Germany [Schumann & Pietzner, 2009] D 2.6b National report on the results of the comparative study of CCS communication methods in Greece [Markos et al., 2009] D 2.6c National report on the results of the comparative study of CCS communication methods in Norway [Næss et al., 2010] D 2.6d National report on the results of the comparative study of CCS communication methods in Romania [Cismaru et al., 2010] D 2.6e National report on the results of the comparative study of CCS communication methods in the Netherlands [Ter Mors et al., 2009] D 2.6f National report on the results of the comparative study of CCS communication methods in the United Kingdom [Reiner et al., 2010b] D 2.7 Report on the results of cross-national analyses of the WP2 data (cross-national report) [Terwel et al., 2009]

Work package	Deliverables
<p>WP3:</p> <p>Representative surveys of public awareness, knowledge and opinions concerning CCS</p>	<p>D 3.1 Questionnaire for national surveys</p> <p>D 3.2 Questionnaire for combined national and regional surveys</p> <p>D 3.3 Report on the analysis and comparison of the results of the national surveys (cross-national report) [Pietzner et al., 2010]</p> <p>D 3.4 Report on the analysis and comparison of the results of the regional surveys (cross-regional report) [Reiner et al., 2010a]</p>
<p>WP4:</p> <p>Development of recommendations for CCS communication and dissemination activities</p>	<p>D 4.1 Project homepage: <a href="http://www.ccs-communications.gr/">http://www.ccs-communications.gr/</a></p> <p>D 4.2 Newsletters (three editions are already published, the fourth will be published after the workshop in May 2010)</p> <p>D 4.3 Report on recommendations for CCS communication [Ziogou et al., 2010]</p>

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