MAPPING OPINION SHAPING FACTORS THAT INFLUENCE ACCEPTANCE OF CCS PRIOR TO AND AFTER CCS PROJECT PLANNING

Work Package 1.3

NEAR CO_2- New participation and communication strategies for neighbours of CO_2 capture and storage operations

Jane Desbarats (IEEP)
Suzanne Brunsting (ECN)
Elisabeth Duetschke (ISI Fraunhofer)
Paul Upham (Tyndall Centre, University of Manchester)
Marjolein de Best Waldhober (ECN)
Christian Oltra (CIEMAT)
Hauke Riesch (Judge Business School, University of Cambridge)
David Reiner (Judge Business School, University of Cambridge)

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Acronyms

CCS	Carbon Capture and Storage
EC	European Community
EU	European Union
MW	Megawatt
NGO	Non-Governmental Organization
PUS	Public understanding of science
STS	Science and technology studies

EXECUTIVE SUMMARY

Public opinion on carbon capture and storage (CCS) is a critical determinant of either technology acceptance or rejection, and can impact the way in which projects are implemented. While levels of general awareness on CCS are still low, public opposition is growing in areas in which CCS projects are underway. Prior research has shown that the way in which project related communication and participation processes are handled, has a significant influence on the formation of public opinion CCS. Factors associated with the delivery of communication and participation strategies such as the identity of the messenger, combined with factors that are endemic to specific projects such as local culture, all influence the formation of public opinion.

The aim of this report is to provide an overview of factors that shape public opinion on CCS operations and the relevant siting issues. This overview is based on (1) a brainstorm session undertaken by the project team, (2) an introduction to the wider context of opinion shaping factors from several research perspectives, and (3) a thorough analysis of components discussed in communication research, with a particular emphasis on input factors (such as the message source) and output factors (measures of effectiveness, for example on knowledge). This basis is then applied to (4) an exemplary review of prior research on communication on CCS, and compared to the (5) results from the case studies undertaken in task 1.2. Factors are identified are summarized in a graphical overview and are discussed in the concluding section.

The conclusions drawn as a result of this report indicate that there are multiple interacting factors that influence public opinion. The complex relationships between these interacting factors underline the importance of studying target groups and contextual factors prior to and following the announcement of a project. At the same time, close monitoring and timely adjustment of communication outcomes is necessary throughout the course of the project. In order to address different thought processes among different demographic and socio-economic strata, this report also emphasizes the fact that enabling effective communication strategies in relation to CCS will only be successful if a multi-channel, multi-source approach for disseminating information and inducing discussion is used.

1 INTRODUCTION

1.1 Report Outline

This report represents the third deliverable of Work Package 1 of the Near CO_2 project, and provides an overview of factors that potentially influence public opinion on carbon capture and storage (CCS). The structure of this report is as follows. Firstly, we describe the objective of this project and the methodology used. Secondly, we describe the results of our brainstorming activities and provide a literature review. The literature review provides an overview of how opinion shaping factors are developed through the presentation of four consecutive figures. Thirdly, we link these results to findings from the analysis of case studies completed as part of Work Package 1.2. Finally, we summarize the results and draw conclusions.

1.2 Project Objective and Methodology

The term 'opinion shaping factor' as considered in the context of this particular project refers to variables that influence public opinion of CCS. In this project, factors influencing public perception of CCS projects in a *local context* are of particular interest. The report aims to identify a broad range of factors that might shape public opinion either prior to project announcement or after a CCS-operation has been planned (or throughout both stages).

Prior research completed as part of WP1.2 of the Near CO2-project indicates that it is possible to influence public opinion shaping and discussion processes via appropriate communication and involvement strategies with the purpose of engaging in effective dialogues between stakeholders and the general public. From our perspective, appropriate communication and engagement strategies enable the public to form an opinion that is based on understandable, balanced information. Such information may prevent the formation of misperceptions or can even correct them. This is not to say that good CCS communication and involvement strategies will lead to the absence of opposition or the suppression of debate. Good CCS information strategies would not avoid debate. Rather, it would ensure that the debate was properly informed.

It is the overall aim of the Near CO2 project to further the development of robust communication and engagement strategies. The identification of factors in this report may contribute to the development of such strategies or communication tools.

In order to provide the broadest possible scope of opinion shaping factors, this report utilizes a variety of methods. Firstly, the project team has undertaken a brainstorm session in order to develop an overview summarizing factors based on “out of the box” thinking. Secondly, partners have drawn on their respective areas of expertise in completing a literature review. This literature review serves to provide an overview of both empirical and theoretical observations relevant to distinct research areas, while also contributing to the development of an applicable analytical framework. Thirdly, drawing on the case study results from WP 1.2, findings from literature are extended and validated based on recent research in the context of the project. These findings supplement the analysis by providing an overview of factors that have impacted the shaping of opinions in the context of actual project implementation.

2 BRAINSTORM AND LITERATURE REVIEW

As a result of a meeting held at the Brussels office of IEEP on June 4th 2009, members of the Near CO2 project team initiated discussions around the development of an overview of opinion shaping factors. These discussions aimed to create of an overview of factors, based on the following criteria:

- The dependent variable examined is public opinion. The range of opinion extends from outright opposition to the technology to complete acceptance, with neutral opinions being a possible outcome. Neutral opinions encompass indifferent attitudes due to low awareness and a balanced perception of disadvantages and advantages.
- The overview will be schematic since it will be accompanied by text to help explain the nature of some of the opinion shaping factors.
- The opinion shaping factors represented in the overview should reflect the position of an individual (as opposed to the general public) impacted by the potential implementation of a CCS plant.
- The eventual goal of the overview will be to help determine which factors would need to be considered in developing communication and participation activities either prior to project announcement, or after an operation has been planned.

Using the brainstorm outcome as a basis for analysis, partners have reviewed some of the relevant literature for the purposes of this report. In section 2.1 the stage is set by introducing the wider context of opinion shaping factors that need to be taken into account for this kind of analysis. In section 2.2 the literature that focuses more narrowly on communication issues is reviewed. In this part of the report, the framework for establishing the overview of factors is laid out. In section 2.3 the literature specifically related to communication on CCS is reviewed. Exemplary references to prior research are used to deepen the understanding of factors summarized in the overview given beforehand.

2.1 Wider Context of Opinion Shaping Factors

There are many levels at which one may study public opinion formation, ranging from societal level to the individual level. In line with the focus of the NearCO_2 project, the focus in this report is on opinion shaping factors that can be attributed to the individual and to a given project; these factors are assumed to be relevant to the communication process between stakeholders and the lay public at either the national or local level. While individual opinion

shapers as described in this report are derived from the field of communication theory, designing and implementing successful communication and participation strategies should consider the wider context of academic literatures, disciplines, and concepts that relate to communication. These include local contingencies or the wider institutional, social, and cultural context in which public opinion is shaped. Figure 1 illustrates this context, though by no means comprehensively: the linkages potentially extend across the social sciences and other areas and perspectives.

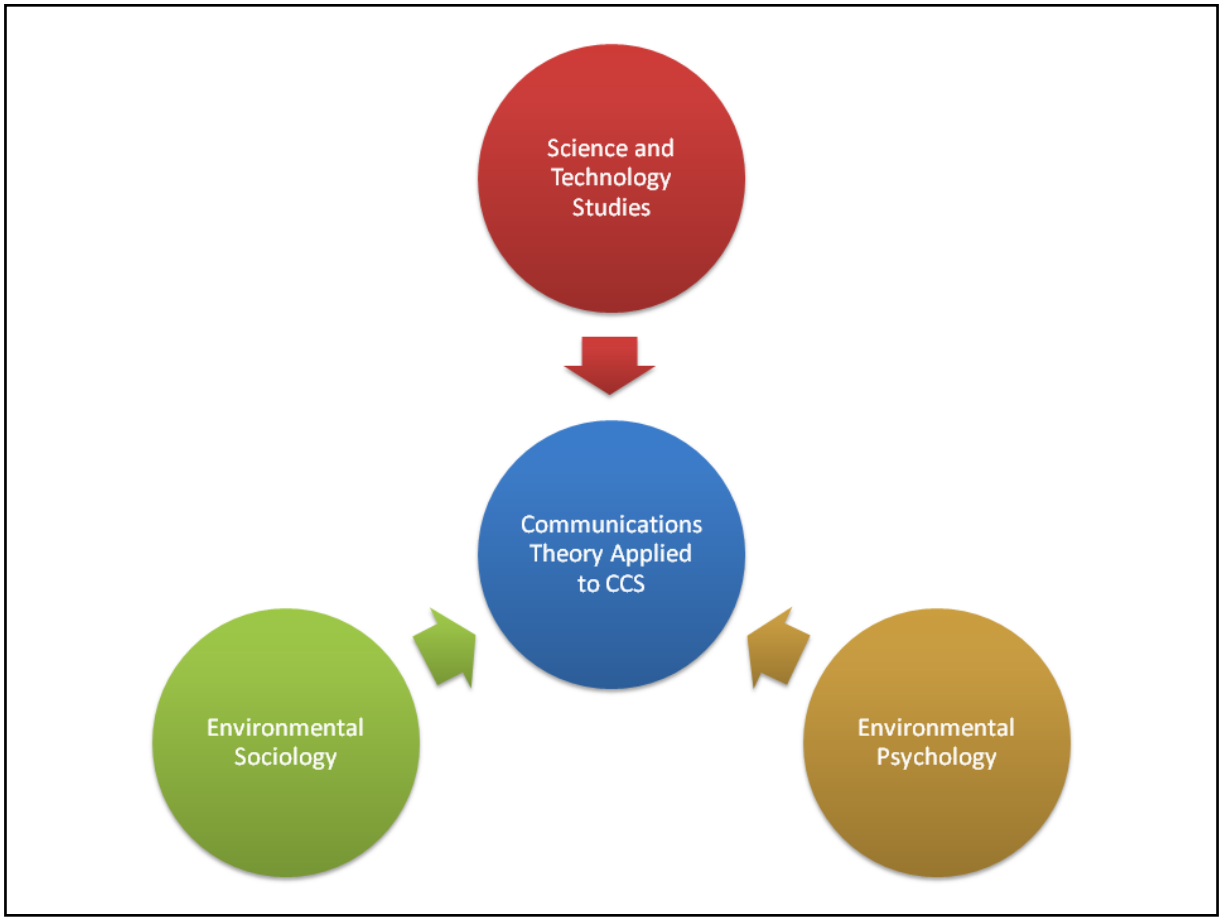

Figure 1 Communication Theory in Context

With reference to Figure 1, drawing on Upham, Whitmarsh, Poortinga, Purdam, and Devine-Wright (2009) and begining with *Science and Technology Studies (STS)*, STS offers challenging insights into the way in which the public interact with science and technology. STS tends to be critical of work conducted in the field of 'public understanding of science' (PUS). PUS is primarily educational in its objectives and tends to assume a lack of knowledge on the part of the public (Sismundo, 2004). In terms of public responses to risk, disagreement with expert assessments was initially characterised within the PUS literature as ignorance, then misunderstanding, and finally as a desire for an impossible 'zero risk' (Wynne, 1995). Writing from an STS perspective, Wynne (1995) is among those who have argued that this

understates the public's level of understanding and results more from experts' unwillingness to recognise and openly discuss the conditionality of their own work and the normative commitments that it embodies. In short, STS exemplifies lines of thought that give a high priority to the legitimacy of debate, rather than emphasizing public engagement and communication for the purpose of persuasion. It is important to remember that there are real policy debates in relation to CCS and that there are real scientific uncertainties: in communication terms, attempting to deny this is unlikely to be successful, and we take account of these insights in our own scoping of opinion-shaping factors.

Environmental Psychology is perhaps less politically challenging than STS but is also a broad field with much to contribute to communication theory and programmes. In WP1.2 we emphasise, for example, the relevance of thinking on place attachment, drawing on a review related to public objections to renewable energy developments (Devine-Wright, 2009). Similarly, place identity refers to the ways in which physical and symbolic attributes of particular locations contribute to an individual's sense of self or identity (Proshansky, Fabian, & Kaminoff, 1983). Change to a location is sometimes termed a 'disruption' to place attachment (Brown & Perkins, 1992) or a 'threat' to place identity (Bonaiuto, 1996). We take account of these and many other insights below, most notably on risk perception.

Environmental sociology takes a very different approach to environmental behaviour and attitude change. An increasingly popular theoretical approach in this field is that of 'practices', from the sub-field of the sociology of consumption. In explaining attitudes and behaviour, the practices literature emphasises the role of habits, routines and the social and technological systems into which people fit, rather than attitudes per se. Sociological approaches to environmentally-relevant behavior view socially-learned habits or practices as of primary significance and attitudes as a consequence of these - e.g. (Shove, 2009). The implications of this for fossil CCS are positive: for consumers, CCS is a relatively business-as-usual technology. Although it does require new infrastructure, it reduces the need for a very rapid and much larger expansion of renewable energy infrastructure and it does not, in and of itself, require demand reduction. Emphasising the potential of CCS for maintaining familiar environments and ways of life would be one communication implication of environmental sociology.

To conclude, the outcome of communication and participation strategies around specific projects will be shaped in the broader context of cultural, social, and psychological factors. Thus, although the focus in the remainder of this report is on communication theory, a wide range of literatures and concepts can and will inform our thinking throughout this project.

2.2 Features of Communication Shaping Public Opinion

In undertaking the brainstorming exercise, the project team found it helpful to group opinion shaping factors according to the communication-persuasion matrix by McGuire (2001), see Figure 2. The central idea of this matrix is that features of the communication 'input factors' – the *source* of a message, the *message* itself, the *channel* through which it is distributed, and characteristics of the *receiver* of the message - together influence possible communication outcomes called 'output factors' which will be discussed in detail below. Secondly, we will discuss the interdependency between output and input factors. Thirdly, we will discuss relevant features of each of the communication input factors. The results of these analyses will be summarised in an extended overview further down.

		communication input factors			
		source	message	channel	receiver
communication output factors (steps in communication process)	exposure				
	attention				
	interest				
	understanding				
	thoughts generated				
	attitude formation				
	storage in memory				
	search & retrieval				
	decision				
	action				
	feedback				
	consolidation				

Figure 2 McGuire's Communication-Persuasion Matrix. Adapted from Petty, Priester, & Briñol (2002).

Communication Output Factors

The communication output factors listed in the matrix show which conscious and unconscious cognitive processes are influenced by communication and participation efforts. To a large extent, these processes are sequential and can therefore also be called 'steps' in the communication process. Below we will explain each of these steps by taking a project information leaflet as an example of communication.

Exposure simply means whether someone has been exposed to the communication effort. In this example, exposure means having seen the leaflet. We speak of *attention* if the receiver subsequently has taken a closer look at the leaflet. In general, someone will only start reading a leaflet when he or she takes *interest* in its contents. When this happens, the next determinant of effect is *understanding*. For several reasons, the receiver may interpret the information differently than intended by the sender. For example, the information may be too difficult or

not interesting enough to take the effort to understand. In any case, the type of *thoughts generated* after processing the leaflet will clearly depend on the effects of communication on the previous factors. Subsequently, thoughts generated will influence *attitude formation* about the topic of the leaflet, for example a specific local CCS project. If this attitude is *stored in memory*, it may be *retrieved* from memory the next time the project comes to mind (for example in response to new information or discussion with peers). Depending on the type of attitude formed, a person will take a particular *decision* about the project which will influence subsequent behaviour, or *actions* taken. Possible actions are to do nothing, to join a protest group, or to actively show support for the project. Depending on the type of *feedback* one gets after performing this behaviour, this behaviour may persist (*consolidation*) or be altered.

To a large extent, the output steps are sequential. Clearly, if one is not exposed to a message no further processing can take place; if one does not attend to a message no interest can arise; etcetera. In some cases, however, output steps are affected in a different order. Think, for example, about free product trials. You try the product first (action), and then decide what you think of a product (attitude formation). Furthermore, all output factors are interdependent. That is, the way in which one output factor is affected will alter the way in which subsequent factors are affected. For example, if a receiver does not entirely comprehend a message he or she may still develop thoughts about it, but these may differ from thoughts generated by someone who does understand the message.

The interdependency issue is also true for the input factors. Each of the input factors influences the communication outcome in interaction with other input factors. Furthermore, each feature of each input factor may differently affect each of the output factors, and it is impossible to target all output factors in one single effort. This is because different types of input factors are required for different effects. For example, using humour or eye-catching imagery as a *message* feature may be useful for creating attention, but may distract people from the actual message content and thereby inhibit comprehension and memory of the actual message. Communicators – implicitly or explicitly - choose in advance which output factor of a communication or participation effort will have an impact. In doing so, they often expect too much from one message in terms of an effect on output steps. In the next section, we will explain which input factors are important to take into account when designing engagement and communication activities.

Communication Input Factors

Communicators need to realize that knowing as much as possible about their audience before commencing any communication activity is the key to effectiveness. As we will describe below, many features of the communication input factors *source, message, and channel* can be controlled to some extent. However, the input factor *receiver*, while a major determinant of communication effects, is usually beyond communicators' control. Ultimately, if and how communication and participation efforts are received and perceived (output factors) is entirely up to the receiver. In the next section, we therefore first describe features of the receiver to be taken into account when designing communication and participation efforts. In the remaining sections, we describe relevant features of the source, channel, and message that can to a large extent be controlled by communicators to match the features of the receiver.

Receiver

Receivers, not communicators, determine which effect any communication activity will have. For example, chapter 2.1 in this document states that CCS projects could be viewed positively if people realize that it utilizes existing resources without requiring the expansion of existing infrastructure typically associated with renewable energy. However, assessment of this advantage of CCS in communication will not necessarily result in more positive attitudes towards CCS. Amongst other, this would require people to (1) comprehend that CCS and renewable energy are at least to some degree interchangeable in the context of energy supply options, (2) appreciate a solution that will be out of sight (underground CCS storage) rather than a solution with a high visual impact (such as wind turbines), and (3) think that this benefit outweighs possible perceived disadvantages of CCS.[1] This example illustrates the importance of formative research on the current awareness and knowledge levels as well as already held opinions among the target audience. Listed below are clusters of relevant audience features which should be examined in such formative research.

Receiver features can be clustered into three types. Firstly, geographical variables, such as region, postal code, and distance to the planned CCS project; and socio-economic variables such as age, gender, education, income, and employment. Secondly, individual psychosocial variables such as current knowledge, opinions, and behavior towards CCS technology, climate change, alternative energy solutions, and the relation between CCS and climate mitigation. Thirdly, individual psychosocial variables such as current knowledge, opinions, and behavior, towards a specific CCS project. These perceptions may differ from general

[1] . This example is used to illustrate the potential impact of communication strategies. It is not meant to provide a positive endorsement of the technology.

perceptions on CCS and can be related to, for example, perceived procedural justice, perceived fairness in distribution of costs/benefits, or perceived quality of information, communication, and participation efforts. Contextual factors, such as prior activities of the project developer in the area or the presence of other industrial projects, will also influence perceptions of specific CCS projects.

Individual perceptions are also related to socio-demographic variables. Stephens et. al. (2009) found, for example, that the levels of CCS acceptance tended to vary by age, gender, education and occupation. Younger and more educated individuals tended to increase their support for CCS with greater access to information whereas older and less educated individuals did not. Furthermore, it is often assumed that people with a technical education will have a more positive view on CCS than those lacking a technical background. Up to now however, there is no empirical evidence to support this.

Prior awareness, knowledge, behavior and attitudes will influence the effects of exposure to new messages about CCS or particular CCS projects. Therefore, communication and participation efforts should seek to match these variables. However, there is a fourth factor that influences how people process information on CCS: Their level of perceived involvement with CCS technology in general and specific CCS projects. Communicators typically overestimate the extent to which the general public feels involved in their topic, in this case CCS, and related issues. Involvement, also known as personal relevance, is the extent to which someone judges an issue to be of importance to him or her personally. Involvement is thus not a feature of the issue, but a feature of the receiver. If one lives on top of a prospective CCS storage site but does not care about this, involvement with the CCS project is low.

Types of involvement are (1) outcome-relevant involvement, that is, whether the project is perceived to have effects that the recipient considers personally relevant (e.g., employment), and (2) value-relevant involvement, that is, whether the project is perceived to have effects that are not necessarily direct physical benefits but that are relevant to the receiver's values (e.g., contribution to climate effort). In most cases, both types of involvement will play a role to some extent, but their prevalence may differ depending on the topic and the situation. Currently, in CCS projects, outcome-relevant involvement seems to prevail. One possible explanation is that the local public often perceives the costs and benefits to be unequally distributed between the project developer and the local community. We will address this further below when discussing the input factor 'message'.

Petty and Cacioppo's (1986) 'Elaboration Likelihood Model of Persuasion' (ELM) illustrates how level of involvement, or 'motivation' as it is called in their model, influences both the extent to and the way in which people process information. Everyday, we are bombarded with information from a variety of sources, ranging from street advertisements to newspaper articles. However, our cognitive capacity to process all this information is limited. Therefore, all of us use mental shortcuts to reduce the amount of information (by ignoring a large part of it altogether) and to simplify processing of the information that is left. According to the ELM, the degree of message processing mainly depends on the perceived personal relevance of a topic (Petty & Cacioppo, 1986; Petty et al., 2002). The more someone perceives an issue to be personally relevant, the more likely he or she is to process messages on this issue thoroughly, through the so-called central route; when we regard information as relevant to us, we will scrutinize a message carefully and think about its content, using prior experience and knowledge to determine whether or not the advocated position in the message has merits. Central processing of information results in stable attitudes towards the issue in question; attitudes that are resistant to change resulting from the presentation of new information.

If, however, we perceive the personal relevance of information to be low, we will process a message only superficially through the so-called peripheral route. Using this route, people will pay little attention to the message content, but instead judge a message by other, so-called 'heuristic' features such as the number of arguments given (e.g., 'they give many arguments so they will probably have thought about this') or the presence of an expert who delivers the message (e.g., 'if an expert tells me this, it must be correct'). This implies that people who do not consider themselves stakeholders in the project will only process messages superficially. Peripheral processing of information results in unstable attitudes towards the issue in question that are likely to change after presentation of new information.

Whereas involvement is a major determinant of how people will process information, actual message processing is also influenced by opportunity and ability (MacInnis, Moorman, & Jaworski, 1991). Opportunity is partly determined by the context in which a message is received, such has having enough time to process the message (when in a hurry, people will also skim information on topics they consider relevant). Another determinant is the availability of information and invitations to participate in engagement efforts. Ability to process information and to participate depends, amongst others, on the complexity of information and on the timing of participation activities. For example, when a town hall meeting is organized on a weekday, people who have to work will be unable to attend. Finally, a general predictor of information processing is the general desire of an individual to keep up to date with current events, known as 'need for cognition'. Ultimately, all of the

above will result in selective attention to information, selective perception of information, and selective interpretation of information based on existing values and beliefs.

To determine how communication and participation efforts will be received, it is necessary to assess the level of involvement of the target audience and to consider their opportunity and ability to process the information presented to them. Communicators can to some extent enhance processing ability and opportunity themselves, for example by choosing internally paced media for complex messages and adjusting communication efforts to the target group's education level. Motivation to process information can be enhanced by ensuring that the audience considers the information as personally relevant. Ways to increase involvement in CCS projects may include the creation of possibilities for project ownership, a sense of control over project continuation and outcomes, perceived procedural justice and public trust in the project developer, personal norms and values, social norms, or perceived effectiveness of CCS to curb global warming. In the case of a CCS project, project ownership could be obtained through public involvement in ongoing project monitoring efforts.

Source

The source of communication and participation activities, also called the 'sender', can either refer to the actual source behind the message (for example, Shell or Vattenfall) or to the representative that embodies the information source (for example, a company spokesperson who gives a presentation at a public meeting). However the representative acting as an information source may also be someone who is not actually employed by the company such as a celebrity stating his or her approval for the company's CCS project in a television commercial or an unknown member of the local public endorsing the project by testimonial in a project leaflet.

When it comes to source effects on communication outcomes, an important feature of the actual source is the power to control the listener's rewards and punishments for compliance. Obviously, people will be more inclined to listen to a message and follow its instructions if the listener is rewarded for doing so and is punished for not doing so. Unless the source is a public authority, the source will usually not be in a position to impose a penalty upon audience members who do not comply with instructions.

When it comes to features of the source as depicted in communication, whether this is an actual company employee, an expert, a regular person or an animated character, source attractiveness is a key variable influencing message effectiveness. The two main determinants of source attractiveness are (1) physical appearance, such as vocal pleasantness, facial

expressiveness, or beauty, and (2) degree of familiarity to the audience. In general, the more similar a source is to the audience in terms of demographics, educational background, appearance, and so on, the more appealing and trustworthy this person will seem to the audience. Typically, however, sources in CCS communication will resemble other groups such as public officials, organization leaders, or experts. Perceived source attractiveness will then depend on how the receiver of the message views the group that is represented by the source. Local members may respond more positively to a message when presented by someone who resembles them (another community member) than when the same message is presented by someone who is not 'one of them' and whom they may not even trust (a project developer). Alternatively, the use of an expert may foster source credibility. Credibility is typically considered a function of a source's perceived expertise, trustworthiness (see below), level of education, familiarity with the subject matter, and presentation style. However, effective use of an expert as a spokesperson requires that the expert is seen as independent and not a project beneficiary (because in this case the expert will be low on trust – a vital opinion shaper).

In the case of infrastructural projects that are the topic of this study, a pivotal source-related variable is trust in the developer of a project and the institutions overseeing the process. Trust in the parties involved to a large extent predicts how communication will be perceived by the public. In the case of CCS, the public is likely to be more receptive to CCS communication when coming from a source that is perceived to have a high degree of expertise and is seen as independent. When people do not trust project developers and regulatory bodies, information from these parties is likely to be perceived as biased, will be distrusted, and ultimately rejected. Only messengers that critically appraise the efforts of industry and government are considered trustworthy. This places tremendous importance on the role of NGOs in informing the public about CCS. Another way of enhancing unbiased message processing is by having a message endorsed by multiple sources with dissimilar interests (ter Mors, Weenig, Ellemers, Daamen, & de Best-Waldhober, 2009). Note however, that although the message will be processed in a less biased way, this will not by definition enhance source credibility.

Message

When thinking about the 'message', the first thing that probably comes to mind is its content. Information related to a CCS project may be for example: information about the project features (e.g., scale, location, timing); announcement of participation opportunity (such as a public meeting); discussion of risks, such as leakage into the atmosphere or basements; discussion of possible disadvantages, such as effect on property values; or discussion of benefits.

However, since the content of messages depends on the topic at hand, on a conceptual level messages are typically classified in more general terms. Rogers and Storey (1987), for example, classify messages and campaigns by (1) level of objective, (2) locus of change, and (3) locus of benefit. Level of objective refers to the output factors the message is designed to impart: to raise awareness, to inform, to instruct, to persuade, or to mobilize the public. Locus of change refers to the population in which a particular change is desired, varying from one individual to the entire society. Locus of benefit refers to the distribution of costs and benefits between the sender and the receiver of the message.

When applied to CCS communication, we can observe a discrepancy in the locus of risks and the locus of benefits discussed. Currently, the benefits of CCS to a community or to the individual are typically national or international (e.g., relevance to the climate effort) whereas the risks are found at the local level (e.g., leakage into basements, decrease in property value). This is problematic because in local CCS communication, where the locus of change is a particular community, the most salient issues will be the risks and benefits at the local level. In considering these, community members are likely to assess that at least on a local level, the project mainly has disadvantages to them, with benefits more for the project developers. According to Curry (2004), the biggest challenge to undertaking communication efforts will be in persuading local populations to accept a technology that may have significant costs and risks to local populations with 'diffuse global benefits'. If local community members are to pay attention to the general risks and benefits of CCS worldwide, they should be addressed at the appropriate locus of change. That is, as members of a nation or continent, or even as world citizens. National governments are generally in a much better position to communicate at this locus of change than project developers. In communication about CCS from national governments the locus of change and the locus of benefit can be aligned, which is much more likely to result in change in the desired level of objective (whether this is merely to create awareness or to foster attitude change towards CCS).

A vast body of knowledge exists on relevant features of single messages, predominantly from the fields of advertising research and health education research. In her research on the development of effective advertisements for motivating healthy behavior, Brunsting (2007) has integrated the main insights from both research areas. Below we briefly summarize main insights resulting from this multidisciplinary approach.

Ideally, a message should have a positive (or at least no adverse) effect on each output factor in the communication process. First, a message should generate awareness: It should be

designed in such a way that the audience attends to it (McGuire, 2001; Zimbardo & Leippe, 1991) and subsequently processes its contents, to remember the advertisement later on (MacInnis et al., 1991). One of the reasons attention is so important is the 'unknown makes unloved' principle. Stephens et. al. (2009) have demonstrated this principle by describing a designated CCS event held with a number of renowned experts, where attendees were given surveys both before and after the event. The event revealed that increased awareness and additional information related to CCS by itself tended to result in increased acceptance of the technology, regardless of the nature of the information provided. Second, a message should be likeable: It should be designed in such a way that the audience appreciates it (Walker & Dubitsky, 1994). This is necessary because if the first response to a message is positive, subsequent information processing is more likely. Furthermore, this information processing is more likely to result in a positive attitude towards the advertisement (Percy & Rossiter, 1992). Third, communication must influence public opinion, commonly known as 'beliefs'. That is, the message should enhance favorable thoughts and feelings about the project and related activities. This may result in a positive overall attitude to the project (Ajzen & Fishbein, 1980). Living up to this principle requires prior knowledge of those thoughts and feelings that most strongly predict the audience's general opinion on CCS.

Message features that mainly address the first output steps in the communication process – exposure, attention, interest, understanding and type of thoughts generated - are part of the *execution strategy*. The execution strategy encompasses the tone of voice and language used in a message. Research has shown positive effects of rhetorical questions, since these invite the public to engage in active thinking. Among higher-educated audiences, metaphors and puns are popular attention-getting devices as well. The use of particular words will color perceptions of the advocated technology or project. Arguably, words such as 'reverse engineering' and 'end-of-pipe solution' are likely to create negative associations with CCS. The term 'demonstration project' may also generate negative associations with CCS technology such that it is unreliable and not ready for large-scale implementation. Some best practices known from communication literature include the use of simplified vocabulary, short sentences, sparse copy, graphic depictions, and a single major point per message.

In contrast to likeability cues, fear appeals are a popular strategy as well. A fear appeal aims to evoke unpleasant arousal in the viewer of the advertisement. This strategy is often encountered in messages about global warming, as this type of appeal is commonly thought to convince the audience of the urgency to take action. Fear appeals are considered to be effective because the right amount of perceived threat will motivate people to reduce the perceived danger by taking the necessary protective measures. However, a growing body of

research shows that fear appeals are often ineffective, because people deny that the situations apply to them or underestimate the severity of the threat (Hastings, Stead, & Webb, 2004).

Message features that mainly address the last output steps in the persuasion process - thoughts generated, attitude, decisions and actions, are part of the *message strategy*. The message strategy refers to the type of appeal that is made to the public. An appeal can be aimed at five types of thoughts: (1) related to informational aspects of a project such as its scope and duration, but also advantages and disadvantages; (2) related to affective/emotional positive and negative consequences, such as reduced quality of life due to industrialization of the area; (3) related to social aspects such as whether one's peers endorse the project; (4) related to empowerment or self-efficacy, for example by offering the opportunity of joint decision-making; or (5) related to personal norms and self-identity, for example someone's pride in being a citizen of an innovation-minded area. These five types of appeals relate to five 'belief clusters' that are commonly discerned in social-psychological behavioral models, which have been applied most extensively in health education research and to a lesser extent also to certain types of environmental behavior, such as littering (Cialdini, Reno, & Kallgren, 1990), recycling (Rise, Thompson, & Verplanken, 2003; Terry, Hogg, & White, 1999), and reduction of energy consumption (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008).. As a rule, the belief cluster targeted in communication should match the cluster of beliefs that is most influential in shaping public opinion.

The use of a particular message strategy often implies the use of a specific format. In informational messages common formats are user testimonials or expert demonstrations, that show what problem the project will solve. Affective messages typically visualize the outcome of a particular action (e.g., this is what your town will look like five years from now). A social or identity strategy may imply the use of a celebrity or public representative of whom the target audience has a positive view. Having such a celebrity endorse a project may result in modeling behavior or, if the celebrity represents particular personal norms, an appeal to self-identity. Strategies and formats are not mutually exclusive and may in practice even be hard to distinguish between. Combinations of different strategies and formats are common.

Apart from the type of arguments used, the number of arguments, argument strength, and framing are other important features of message content. As already described in this report, the number and strength of arguments have different effects depending on whether the receiver of information demonstrates low or high motivation levels in terms of processing information. Furthermore, a message can use a gain or loss frame to make an argument. For example, a message may assess what CCS will contribute to the climate effort, which is a gain

frame. Alternatively, a message may assess the adverse consequences for the climate of not using CCS, which is a loss frame.

Finally, the number of message repetitions, the length of a message, and its complexity are also features to take into account. If a message is repeated only once it is unlikely to be memorized. Research has shown that the optimal number of exposures is 3-5 times. With regard to message length and complexity, it has been found that when recipients have difficulties understanding a message they infer their level of agreement with the message from source credibility (in terms of the previously described ELM, this can be seen as peripheral processing).

Channel

Examples of channels are commonly known media such as television, newspapers, brochures, and the internet. But a channel can also be public meetings, school education programs, or interpersonal communication. On a more specific level, such as within television genres, the term 'channel' may be interpreted as a particular format in which the message is conveyed, such as a documentary, evening news bulletin, opinion letter, or monthly interview.

One important feature of a channel is its so-called 'pacing', referring to the question who controls the speed of information provision. Channels are either externally paced or internally paced. External pacing means that the receiver of information cannot influence the speed of information by stopping, slowing down, or rewinding parts of it. Television, for example, is externally paced, assuming a program is not recorded. Internal pacing means that the receiver is the one who decides how much time he or she takes to process information and whether he or she will skip or re-examine particular parts. The receiver may even decide to stop information processing and resume later on. A newspaper and a brochure, for example, are internally paced.

Another important channel feature is one-sidedness versus two-sidedness. A television program is one-sided: no interaction between sender and receiver is possible. As a result, the program cannot be adjusted to the receiver's needs. In contrast, a public meeting is two-sided. The sender and receiver can interact and the sender can adjust message features such as complexity and type of arguments used to the needs and abilities of receivers. Channel features should match other input factors. For example, when conveying a difficult or long message, an externally paced one-sided medium may not be the best choice. When the topic is new, which is the case with CCS, a channel should preferably be chosen that allows for receivers of the message to ask questions and to repeat information if necessary.

Summary and extension: Placing the communication-persuasion matrix in context

Figure 3 summarizes relevant features of each of the input factors described in the communication-persuasion matrix. As stated above, all of these factors are mutually dependent in terms of influencing communication and participation effects. An additional frame named ‘context’ has been added to this overview to indicate that the communication-persuasion matrix is not an end in itself but has to been seen in a wider framework. This wider framework, including project features, will be further elaborated below.

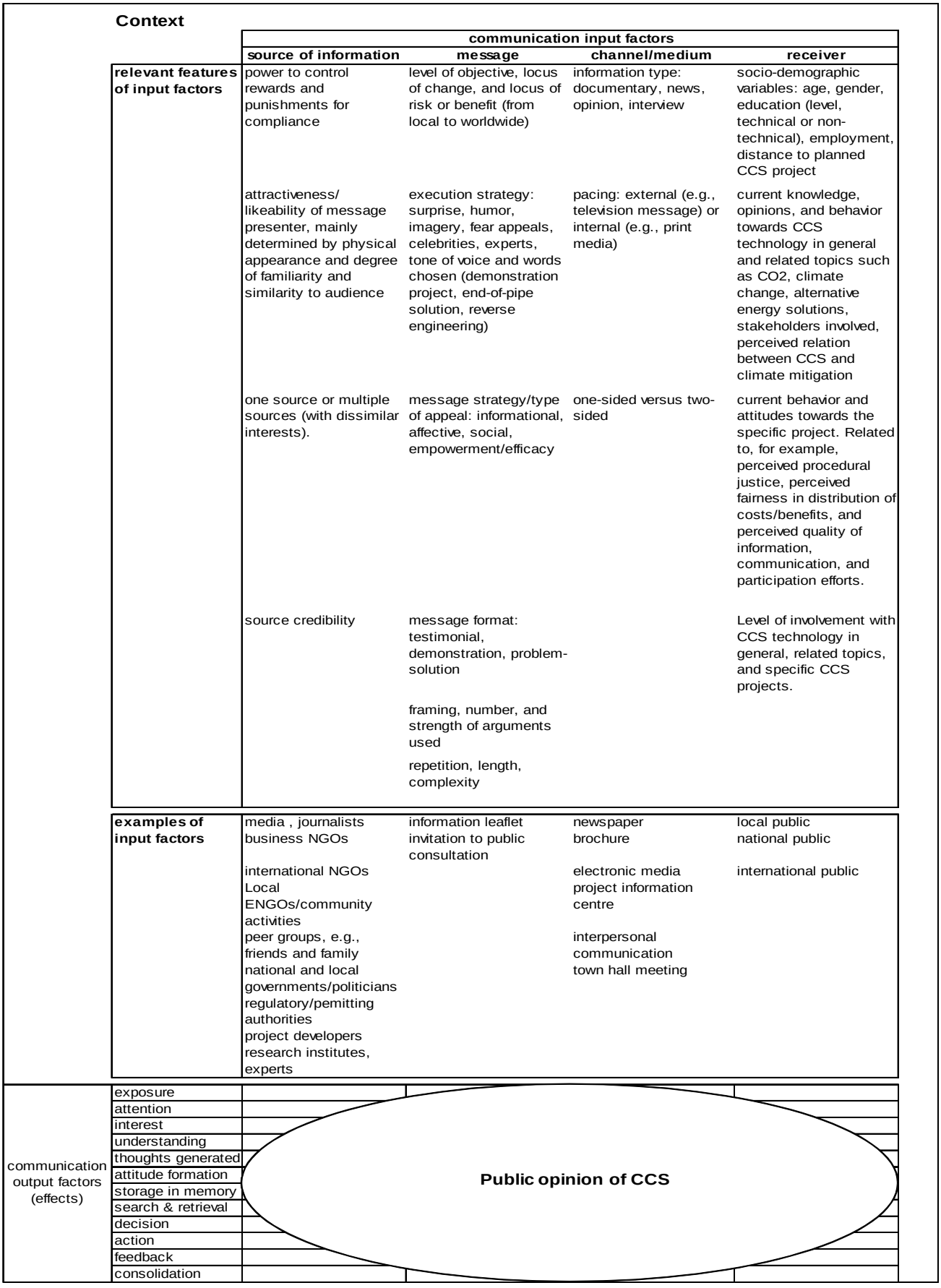

Figure 3 Overview on opinion shaping factors on CCS

Context

In communication research context is often defined at the individual level, referring to features of the physical setting in which the message is received. Relevant features of an individual's physical setting are (1) whether one is alone or with others (when one is with others, interpersonal discussion about the message may occur which influences message processing and outcomes); (2) The presence of distraction during message processing, such as a doorbell ringing while one is watching an explanation on CCS on the news; (3) time pressure during message processing, for example one may be in a hurry to leave a public meeting and may not stay until the end.

Alternatively, context can be defined at the message level. A relevant feature of message context is the amount and nature of other information surrounding the message. For example, a CCS item on television will probably be processed differently if scheduled after an item about climate change than after an item about, for instance, a football match. Furthermore, as described above, information is received differently when the receiver is in a bad mood than when the receiver is in a good mood. Thus, if one's favorite football team just lost, an item on CCS may be received less well than if one's favorite football team just won.

The above examples are meant to illustrate that to a large extent, the effect of communication depends on the context in which it takes place. Contextual factors are never entirely under the sender's control, which makes it all the more important to pay close attention to a good fit between receiver characteristics and communication input factors that are under the sender's control.

On a meso/macro level, as discussed in paragraph 2.1, context may refer to local, national and perhaps even international factors surrounding the project and the relevant communication. Important local project context factors are, amongst others, the history of the project area, the social and economic situation of the project area, media coverage of the project and project-related affairs, and the occurrence of other events or accidents that are, or may be, associated with the project. At the national level, the relevant features include the regulatory context of environmental effects and for public information and participation, the general level of trust/confidence in public authorities, endemic opinion on technology in society, the political system, history of e.g. public protest activities to CCS or related issues, and general media coverage of CCS, climate, and related issues.

Project Features

The variable ‘project features’ is used to describe various characteristics of the project which will contribute to the formation of public opinion. As outlined in the overview, important project features range from timing of the project and of communication and participation efforts therein to the level of factual procedural justice. Project features get shape and meaning within the broader local and national context. For example, concepts such as procedural justice may vary significantly on the basis of local and national legislative context. There is however a noted difference between project features and the way in which these project features are perceived. For example, the way in which a community perceives the level of procedural justice for a given project will be related to other local and national context features (both factual and perceived), such as trust in governments and in the industrial parties involved in the project.

Relevant project features also include advantages and disadvantages of the project. The negative risk related impacts may be, for example, impacts of CO_2 on ecosystems, drinking water and humans in case of leakage, or impact on property values. Benefits may include socio-economic benefits such as job creation or compensation measures. Again, however, there is a difference between factual advantages and disadvantages and perceived advantages and disadvantages among the public. These perceptions may stem from, for example, local contingencies which project developers find difficult to foresee. It is therefore important not only to carry out proper formative research in the target area, but also to create opportunities for dialogue with the public even before the project has started. In so doing, project developers can take note of public needs and concerns and can discuss how the public (or trusted representatives thereof) may be actively involved in decision making. Subsequent communication and participation efforts can be adjusted to the public, increasing the chance that these efforts work out the way they are intended.

Figure 4 shows the extended overview now also including several levels of contextual factors, i.e. national, local, project level as well as current context of the communication. In the next section, we provide an exemplary review of literature specifically related to communication on CCS to illustrate the factors summarized in Figure 4.

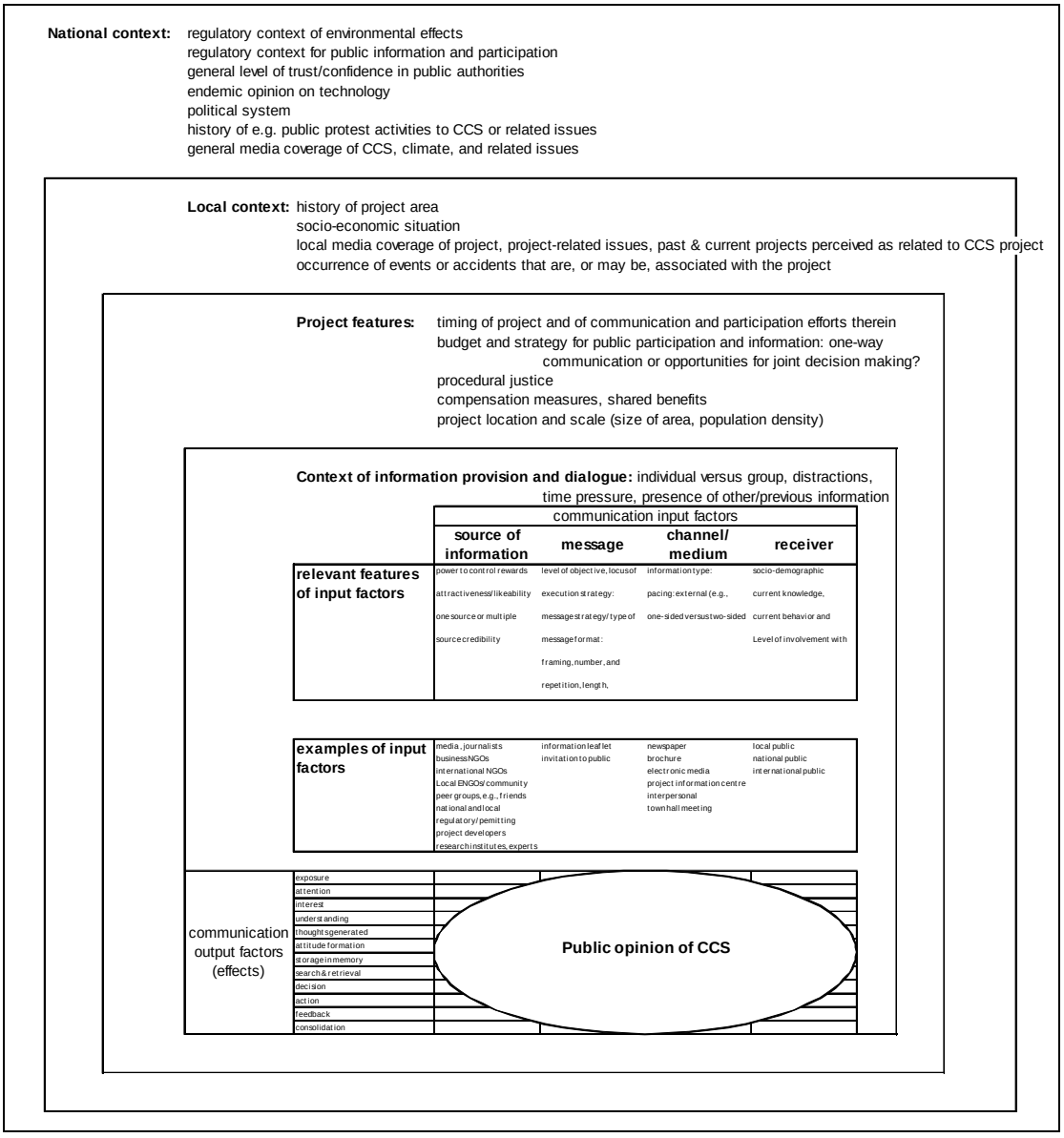

Figure 4 Extended overview including context.

2.3 State of research on communication on CCS

Research systematically analyzing the impact of communication on public acceptance on CCS has just started. Although the number of studies published up to now is limited, they already confirm the complex interplay of factors outlined in section 2.1 and 2.2. In this section, studies are reviewed on an exemplary basis.

Several studies demonstrate that the content of the message delivered influences the communication output. In order **t**o avoid the assessment of unstable pseudo-opinions several studies provided participants with information about CCS, showing that individuals' reactions

to the technology can change with the provision of information (Shackley et al 2004; Itaoka et al. 2004, 2006; Tokushige et al., 2006).

For example, in a survey by Itaoka et al. (2004) carried out in Tokyo and Sapporo in 2003 with 1006 respondents two different questionnaires were applied: one with limited information on CCS and the other with extensive additional information. The provision of extensive information could reduce fundamental opposition, but the effect partly depended on the type of information. The most influential type was information on risks and leakage, which decreased support. Itaoka et al state that "education to help their understanding of issues related to maintaining use of fossil fuel would enhance acceptability of CCS". Similarly, Tokushige et al. (2006) who surveyed 267 students found that acceptance is strongly influenced by the perception of the benefits. After having received information on benefits and on natural analogies, e. g. natural CO_2 accumulations, the perception of risks decreased and acceptance increased

However, changes in responses varied; while in some studies, as in the Japanese ones cited above, participants show a more positive opinion after being informed, in others information led to a more negative opinion. On top of this, some studies show that it is mostly the quality of opinion that changes, with accurate, balanced and understandable information leading to more stable opinions (De Best-Waldhober et al, 2008; 2009; Daamen et al, 2006). These differences in results are probably due to the multitude of factors influencing the output of communication as well as the interaction between those factors (cf. section 2.2).

This is further exemplified by the work of Thomas E. Curry (2004) who analysed public opinion on CCS by looking at relationships between opinion shaping and external influences such as the presentation of information. The results based on a sample of the U.S. population of the survey indicate that appealing to people's appreciation for global warming could impact acceptance of CCS, but only among those that are willing to compromise their lifestyles in order to help pay for the climate change effort. Thus, how the message is framed is related to its effect – however only for certain groups of receivers.

The interaction of factors was also observed in research undertaken by Oltra et al. (2009). As a result of focus groups held throughout Spain related to CCS acceptance, Oltra et al demonstrated that the type of attitude formed on CCS depended on which kind of information was sought by the study participants: Attendees expressing uncertainty related to the technology requested more information; those expressing acceptance were encouraged most by the benefits of the technology; those rejecting the technology were mostly concerned with

the risks; those who were ambivalent questioned the cost. Information needs as well as opinions also varied in relation to local contingencies, e.g. industrialisation of the area; socio-demographic and attitudinal variables, i.e. the national and local context; and attributes of the receiver. These factors turned out to be interconnected and to jointly influence the opinion held by participants.

The interplay of source and message has also been subject to research: In an experimental study, effects of congruence of source and message were analyzed for CCS by Terwel et al. (2010). The source of communication was either an NGO or industrial party, and the issues communicated were either environmental or economic arguments in favour of CCS. The hypothesis was that trust in organisations is higher after the provision of arguments that are congruent with the attributed motive than after the provision of incongruent arguments. The results did indeed point in this direction, but were not significant.

A related study was conducted by ter Mors et al. (2006). The results show that the characteristics of communicators influence quality perception and acceptance of a message, but that this influence is weaker when communicator characteristics are incongruent. This implies that proponents – or opponents – of CCS need to be seen as both competent and trustworthy, in order to be convincing.

A recent study in local communities by Bradbury et al (2009) showed that an important factor for the opinion of CCS was past experience with government, existing low socioeconomic status, and/or desire for compensation. Benefits of CCS to the community were observed to be of greater concern than the concern about the risks of the technology itself. Relating the results of this study to Figure 4, Bradbury et al. (2009) confirm the impact of receivers' attributes as well as project features as part of the context in which the communication takes place.

To sum up, although only few aspects with regard to communication input and output have been researched in the area of CCS – and although this literature review is certainly not exhaustive – results tend to confirm the complex interplay of the various factors described in section 2.2. Thus, the number of factors likely to be influential is enormous and sets a challenge to those developing communication strategies.

3 RESULTS OF CASE STUDY ANALYSIS

The case study analysis completed as part of WP1.2 looked at the implementation of projects utilizing different technology types in areas throughout Europe. The communication and consultations aspects of carbon capture and storage projects were reviewed for projects in Germany and the Netherlands. Similar analysis was completed for biomass to energy projects in the United Kingdom, a gas pipeline in the United Kingdom, a wind project in the Netherlands, and a combined cycle gas turbine project in Spain.

The case studies provided a number of conclusions with respect to the effectiveness of the communication and involvement strategies used. It revealed what elements of communication with the public need to be considered in order to enable the public to understand what the project is about and create an informed opinion about it. Below, we apply the categories we used as a basis for the overview on opinion shaping factors to describe the conclusions from the case study analysis.

Source – Who is presenting information?

Nearly all of the case studies indicate that public perceptions of a self-interested private sector entity pose a significant challenge to acceptance of the technology. The public involved in the project implementation process for seven out of the eight projects reviewed questioned the profit-making motives of project developers, causing them to consider communication materials from these parties as too positive given that they do not typically outline the risks and other disadvantages of project implementation outright. This seems particularly true in the case of CCS related information. We observed that projects that were being developed by large scale corporations such as Shell (Barendrecht, the Netherlands) or Vattenfall (Beeskow, Germany) were sceptically viewed by the public, whereas in Ketzin, Germany, where the project was initiated by a local academic institute, the public had a much more positive or neutral view on the project.

Project Features – When is information being presented?

The opposition voiced in relation to seven of the eight case studies was most significantly heightened by the failure to involve the public at the initial stages of the consultation process. This posed a significant challenge for some projects, given that locations have to be determined before a consultation and outreach program could even be justified by project developers. That said, even after the location has been determined it is still possible to engage the public in effective dialogue by exploring together how project implementation could be done in such a way that benefits and burdens are shared in a way perceived fair to all parties.

Message – What information is being provided?

In cases where proactive CCS communication was undertaken, there is some indication that attempts were made to link the project in question to positive environmental outcomes. Generally speaking, based on the information provided as part of the case study material, it does not appear that the CCS and non-CCS projects sought to emphasise the wider environmental and energy planning contexts. Although results from several studies indicate a lack of public understanding about the larger context (Bulkeley, 2000; Whitmarsh, 2009), public understanding of the use and necessity of CCS in a broader context is often taken for granted. As a result, the information provided by stakeholders such as project developers and public bodies often mismatches the receivers' knowledge levels and information needs, resulting in neglect of the message or in another interpretation of the information as intended by the source. This would certainly be something to consider for future CCS projects. Since the wider context is related to a country's general vision and policies on energy, placing a project in a wider context seems mainly a task for national and local governments.

Channel – By what means is information being presented?

The case study analysis demonstrated that project developers typically use a variety of methods to provide information to the general public. These include: public meetings; the distribution of questionnaires or information leaflets to residents in the project vicinity; the establishment of local information centres that display project details; the establishment of project dedicated internet sites; and in the case of the Beeskow (Germany) and Barendrecht (the Netherlands) project, the installation of a telephone hotline. Efforts by project developers range from providing the bare minimum in terms of information provision, complying only with the basics of the planning process, to providing more sophisticated communication tools.

Context/Receiver

Issues related to context and to receiver in the context of the case study analysis raised some interesting questions about the relationship between communication and decisions made with respect to project implementation. Given issues related to local context and to the characteristics of different types of receivers, projects may have been either significantly delayed, or may have been implemented in the face of ongoing local opposition. It remains unclear, however, how exactly communication and participation efforts have affected the general local public and if these efforts have worsened or inhibited the development of public protest. To our knowledge, evaluation of communication and participation activities has not taken place.

4 OVERALL CONCLUSIONS

Theories and approaches to public opinion as shaped by communication efforts draw on examples that relate primarily to consumer behaviour which have up to now found their broadest application in the research related to advertising, health education, and health promotion. Applying this literature to CCS has helped to illustrate how factors can be attributed to different elements of communication; elements which need to be considered in developing effective communication strategies. Academic work specific to CCS and public perception supplements existing theory by confirming the complex interplay of factors.

In line with this analysis, results from the case studies showed no clear effects with regard to single factors. Conclusions are only meaningful if the interplay between factors is taken into account as well as the contextual conditions. Thus, communication strategies on CCS face the challenge of trying to control a multitude of relationships and variables that can probably never be fully controlled. However, some conclusions can be drawn from this report which may not apply for all projects but at least for a majority of them.

The complexity of the relationships between variables is also a function of a given project cycle. As such, the way in which opinions are shaped must be considered both prior to the announcement of a project and after. The description of opinion factors as outlined in this report has been based on the development of individual perception at both stages of a project. The consideration of contextual factors that exist prior to the announcement of a project ensures that features endemic to a given location are considered in terms of addressing existing perceptions. It underlines the importance of considering local demographics and socio-economic make-up.

Context/Receiver

The receiver and his or her attributes as well as the general context are usually outside the control of the communicator. Thus identifying the position of the receiver as well as the relevant contextual factors are perhaps the most important steps prior to project announcement. It is always down to the receiver who decides how any type of communication is processed and how this affects his or her thoughts. Thus the receiver needs to be studied in order to determine what information should be conveyed (message), how (channel), and by whom (source). Therefore, the single most useful advice that can be given to anyone who wishes to engage in a fruitful discussion about local CCS-projects is to engage in a selfless process of getting to know the target community members by listening to them and by making

an effort to understand what matters to them. This will also lead to the identification of important contextual factors that will also influence the output of the communication process.

Message

Research has shown that information needs depend on the given situation and the context as well as attributes of the receiver. Additionally, expectations and beliefs about the source influence whether the message delivered is deemed to be credible. Thus a multi-channel multi-source approach is recommended to deliver the information. It is also crucial that messages are delivered to the receiver at the onset of project development, and that they are easily accessed by all members of the general public.

Source/Channel

CCS is supported by governments, and is endorsed by a number of prominent experts on greenhouse gas mitigation. As the case studies themselves illustrate, particularly in relation to Barendrecht in the Netherlands, corporate and government endorsement of the technology has only served to heighten public opposition. Although it is possible, given the urgency of the climate change issue, that many projects will be implemented despite a negative public opinion (Curry, 2004), global acceptance of the technology will be beneficial as part of the replication process. For this reason, it will still be necessary to instil a sense of public trust in the source of information. The way in which information is delivered (channel) will be crucial in order to raise awareness and public understanding of both climate change, and the potential for CCS to mitigate greenhouse gases.

It is the general aim of the NearCO_2 project to integrate the results of the analyses undertaken in this step into the development of a communication/participation strategy for WP3. The survey work undertaken in WP2 will help determine which factors are the most crucial in a CCS context.

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