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Effective risk communication and CCS: the road to success in Europe

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Over the past ten years or so, there have been multiple attempts to site and build carbon capture and storage (CCS) facilities in Europe, North America and elsewhere. To date, most of those attempts have not been successful. In Europe, for example, there are currently no commercial CCS facilities in operation. There are a number of reasons for this, ranging from lack of political will, the collapsing price of CO_2, lack of commercial drivers to capture and store CO_2, and public opposition to the proposed facilities. There have been several case studies examining the communication challenges associated with the siting of CCS facilities. Up till now, most of this research has been carried out by climate change or carbon policy experts as well as social researchers rather than scientists representing the wider risk communication community, aside from some notable exceptions. This study does the opposite by examining CCS from a broader risk communication perspective. It provides a brief overview of risk communication theory in order to situate some of the findings of the CCS communication research, and then, it makes some recommendations on how the siting of CCS facilities could be improved including the importance of trust, proactive communication and early stakeholder involvement. In conclusion, this study notes that if the science associated with the technology is communicated in the correct manner and if the key risk communication recommendations are adhered to, then the siting of future CCS facilities should be successful.

Keywords: risk communication; CCS; Europe

1. Introduction

There are a number of reasons why the siting of carbon capture and storage (CCS) facilities in Europe have not been successful, ranging from lack of funding (e.g. no business case), collapse of the CO_2 price, lack of and at times change of political leadership, and public opposition. The aim of this study was to focus on one of these reasons in some detail, namely public opposition by taking a broader risk communication perspective. It seeks to identify from the risk communication literature some key ideas and concepts that could help move the discussion forward. To do this, the literature of the past ten years of CCS communication was compared and contrasted with the wider developments in the risk communication field. This comparison gives rise to a set of recommended future research avenues and practical suggestions which are summarized in the final section of the study.

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2. Background

There is a need for full-scale commercial CCS to become successful if Europe, which is serious about reaching its reduction of CO_2 emissions by the year 2050. Indeed, some observers note that CCS may actually be

> … the only option available to reduce direct emissions from industrial processes at the large scale in the long term (European Commission 2014).

Yet the siting of CCS facilities because of public opposition at the present time is still difficult to do, as witnessed by the Janschwalde, Germany, and Barendrecht, Netherlands, cases (Brunsting, de Best-Waldhorber 2011; Terwel, Ter Mors, and Daamen 2012), even though there has been a large body of work on how to best communicate the benefits and risks of CCS (see for example Ashworth et al. [2010, 2013] for reviews). This raises the question of what is needed now to ensure the successful siting of future commercial CCS facilities from a risk communication perspective. This desk-top research article attempts to address this question.

3. The development of risk communication theory

The school of risk communication grew from the natural hazards work of Gilbert White who looked at why flood damage on flood plains increased year after year, despite large investments in protective measures. His results showed that people's previous experience of floods directly influenced their behaviour when they were again under threat from a possible flood (White 1945). These findings led researchers to theorize that reactions to hazards were based on behavioural factors. Of special interest was that the public perceived natural hazards as Acts of God where there was no one to blame, and hence, they were less concerned about them than technological hazards which were seen to be acts of humans (Burton, Kates, and White 1978; Slovic 2000). In addition, the researchers found that human groups with different social, economic and cultural characteristics, living in diverse geographical areas, would perceive risks in ways reflecting their knowledge and environment (Burton and Kates 1964; Burton, Kates, and White 1978; White 1961). Although this research has been criticized for not taking into enough account the differences between the first and third worlds (e.g. Hewitt 1983), this seminal work had a profound effect on wider risk perception and communication research. These ideas were further developed by Starr who showed that people were 1000 times more willing to take a voluntary risk over an involuntary one (Starr 1969), and it led to the development of the psychometric paradigm which highlighted the importance of familiarity, control, natural vs technological hazard, and dread (Fischhoff et al. 1978; Slovic 1987, 2000). In the late 1980s, researchers began to apply the findings of risk perception research to risk communication (National Research Council [NRC] 1989; Renn 1998; Stern 1991). Whilst risk communication cannot be defined as an independent discipline, it can be described as:

> The flow of information and risk evaluations back and forth between academic experts, regulatory practitioners, interest groups and the general public (Leiss 1996, 86).

Or as stated in CODEX:

> The interactive exchange of information and opinions concerning risk among risk assessors, risk managers and other interested parties (FAO 1998).

Or as the US NRC noted:

> Risk communication is an interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management … successful risk communication does not guarantee that risk management decisions will maximize general welfare; it only ensures that decision makers will understand what is known about the implications for welfare of the available options (US NRC 1989, 21).

Effective risk communication is therefore not a top-down process from expert to lay public, but a constructive discussion between all those involved in the debate about a risk (Fischhoff 2013).

Early research on the effectiveness of risk communication covered nuclear power, chemical and the broader energy sectors (coal burning plants, incinerators) (for good case studies see Leiss 2001; Powell and Leiss 1997). Developers wanted to use the theories and ideas coming out of the risk perception research in order to get their facilities sited on time and on budget. As a result, they employed communication consultants to have them develop programmes (including speeches, brochures and displays) that took into account the various risk perception factors running from involuntary–voluntary, familiar–nonfamiliar and the like. Despite spending considerable amounts of funding on these risk communication programmes, the public remained hostile to the siting of such noxious facilities be they chemical plants, waste incinerators, nuclear power stations or nuclear waste storage sites (Adler and Pittle 1984; Cvetkovich, Keren, and Earle 1986; Slovic and MacGregor 1994). Whilst in part such responses might be attributable to the practical problems associated with the difficulty of getting enough funds to conduct proper evaluations to learn why programmes failed (Chess, Salomone, and Hance 1995; Fischhoff, Brewer, and Downs 2011; Fischhoff 2013; Kasperson and Palmlund 1989), due account must also be taken of the lack of insight by practitioners of the need to work together with the public rather than simply educate them (Fischhoff 1995, 2013; Leiss 1996; Owens 2004; Petts 2004; Wynne 1996). As a result of these limitations, government departments (especially US-based ones) set up large-scale funding initiatives to gain an understanding to some of the underlying reasons why these initial risk communication programmes did not succeed. Amongst the more important factors that academics uncovered were that of *social amplification of risk, lack of trust, and absence of public and stakeholder participation in the siting process* (Boholm and Lofstedt 2004). These variables are discussed in the next sections.

3.1. *Social amplification of risk*

The relationship between media representation of risks and associated public perceptions of these same risks is complex. The theory around social amplification of risk takes into account the integration of different models of risk perception and communication (Kasperson et al. 1988). As Renn notes:

> The social amplification of risk is based on the thesis that events pertaining to hazards interact with psychological, social, institutional and cultural processes in ways that can heighten or attenuate individual and social perceptions of risk and shape risk behaviour (Renn 1991, 287).

The social amplification process is made possible by the occurrence of a risk-related event or by a potential for a risk-related event, such as a plane crash, or a chemical plant explosion. The risk-related event is selected by a 'transmitter', in most cases the mass media, social media (twitter, blogs) or an interpersonal network, which amplifies or attenuates the risk. The transmission is then continued by members of, or institutions within, society who may also attenuate or amplify the risk into a message (which is often referred to as a ripple effect). Such messages lead to secondary effects which can be anything from economic (an amplified shark attack leads to decline in tourist activity) to financial (an amplified flood event can lead to rises in insurance rates) or negative public perception (an amplified chemical plant accident leads to increased public concerns about the use of certain technologies).

Social amplification is underpinned by theoretical models which seek to identify factors that determine what society actually defines as risk, what society does not define as risk and the resulting rationality of the public's response to the risk event itself. Since the initial publication in 1988, the framework has been widely accepted by policy makers, researchers and regulators and it has been applied and used by researchers on both sides of the Atlantic (see for example Bakir 2005; Hill 2001; Löfstedt 2003b, 2008). One of the main reasons to why the framework has become so popular has to do with its comprehensive nature, or as Kasperson et al. argue:

> The framework does … help to clarify phenomena, such as the key role of the mass media in risk communication and the influence of culture on risk processing, providing a template for integrating partial theories and research, and to encourage more interactive and holistic interpretations (Kasperson et al. 2003, 38).

Over the past ten years, the seminal work in this area has been the 2003 Pidgeon et al. volume, *The Social Amplification of Risk* (Pidgeon, Kasperson, and Sloviv 2003), which both built a conceptual foundation for the field and demonstrated how the model is relevant to policy-making.

3.2. The role of trust

Likely explanations for the failure of risk communication initiatives are that public reactions are not only influenced by the message content itself (i.e. what is communicated about the risks and benefits of a hazard) but also by trust in those providing the information, be they policy makers, regulators or developers (Löfstedt 2005; Slovic 1993). Public distrust of policy makers and industry officials is often due to lack of credibility, past history or social alienation (e.g. Cvetkovich and Lofstedt 1999).

Trust, once lost, is difficult to regain (Slovic 1993). It is far easier to destroy trust than to build it, particularly as trust-undermining events tend to be specific events, or accidents, whereas trust building events are more often fuzzy or indistinct such as a good speech by a policy-maker. Concern about the loss of public trust in risk regulators, risk communicators and indeed science in general has resulted in increased interest in the role, more generally, of trust and distrust in society. The issue of who makes decisions that affect others safety or well-being is central to the reactions to potential technological hazards (Beck 1992; Rosa, Renn, and McCright 2014). It is now recognized that greater understanding of what causes or destroys trust could contribute to resolving social, environmental and political problems (Siegrist, Earle, and Gutscher 2007).

3.3. Public and stakeholder involvement

The role of public deliberation in the policy-making process is an area that has received considerable attention (Petts 2004). The need for public dialogue and reciprocal risk communication was recognized in the 1980s when contemporary studies indicated that the most common form of risk communication, so-called top down, was not alleviating public concerns about risks (NRC 1989, 1996). Industry, regulators and policy makers, frustrated by the difficulty of siting energy and waste processing facilities, wanted to build public trust by involving them more directly in the siting and/or policy-making processes (Barber 1983; Petts 2001; Rowe and Frewer 2000). A good example of the use of deliberation was when the US-based International Paper Company (IP) used it to successfully speed up the relicensing of four of its hydropower stations on the Androscoggin River in central Maine. At the time, IP was viewed as a distrusted company in central Maine (Löfstedt 2003a)

Fairness is another major reason for involving affected publics early on in the siting or policy-making processes. Siting of noxious facilities has been shown to be influenced by public perception of procedural and substantial fairness issues (e.g. Albin 1993; Linnerooth-Bayer and Fitzgerald 1996; Renn, Webler, and Kastenholz 1996; Renn, Webler, and Wiedemann 1995; Young 1994). Early involvement can account for a wider range of perspectives and viewpoints (Kunreuther, Fitzgerald, and Aarts 1993; Renn, Webler, and Kastenholz 1996; Renn, Webler, and Wiedemann 1995) and address issues such as under what conditions facilities should be built or under what conditions plans are likely to fail (Petts 1995, 2001).

3.4. The evolution of risk communication

Risk communication as a field has now had a 40-year or so history. Over that time period, the field has evolved considerably. One of the leading thinkers in the field, Baruch Fischhoff, summarized the evolution in seven distinct stages, namely:

- 'All we have to do is get the numbers right'.
- 'All we have to do is to tell them the numbers'.
- 'All we have to do is to explain what we mean by the numbers'.
- 'All we have to do is show them that they've accepted similar risks in the past'.
- 'All we have to show them that it's a good deal for them'.
- 'All we have to do is treat them nice'.
- 'All we have to do is make them partners'.
- 'All of the above' (Fischhoff 1995, 137)

For each of these stages, Fischhoff provides illustrations of some of the key implications of each stage. For example, 'all we have to do is get the numbers right' implies experts just need to get the hard facts right – there is no need for dialogue. On the other hand 'all we have to do is to tell them the numbers' is about transparency and sharing the detail behind the numbers (risk calculations).

Although the object of Fischhoff's article was to show how much the risk communication field had matured and that there are now multiple stages of risk communication, this is not the case for all sectors where risk communication researchers have been active. So it may be true that over time some nuclear operators have now

implemented all of Fischhoff's stages as they have been engaged with risk communicators for many years, but it is certainly not the case for the pharmaceutical sector where researchers have only become more involved over the past ten years (Löfstedt 2003a).

4. Risk communication and CCS

There has been a number of CCS facility siting studies as well as studies examining citizens' views of CCS. These have differentiated between onshore, underground disposal and offshore, underground disposal. These have been undertaken by a range of experts from the fields of economics, geography, psychology and sociology disciplines with interests in climate change policy and CCS (e.g. Bradbury, Greenberg, and Wade 2011; Bradbury et al. 2009; de Best-Waldhorber et al. 2011; Brunsting, Upham et al. 2011; Fleishman, De Bruin, and Morgan 2010; Markusson, Shackley, and Evar 2012; Ter Mors, Terwel, and Daamen 2012; Ter Mors et al. 2010; Terwel, Ter Mors, and Daamen 2012; Wallquist, Visschers, and Siegrist 2010). In addition, a number of review articles have summarized the findings in which the ones by Ashworth et al. being the most detailed (Ashworth et al. 2010, 2013). To be clear, the CCS research area appears to be rather mature, compared to other emerging technologies such as nanotechnology or synthetic biology. Ashworth and colleagues identified no less than 900 + references in their synthesis of social science CCS research of which 14 articles were cited more than three times (Ashworth et al. 2013). In reviewing the literature on the siting of chemical plants or waste incinerators or nuclear power stations (e.g. Boholm and Lofstedt 2004) the siting of CCS facilities in Europe, North America and elsewhere are not especially different or unique compared to siting of other large infrastructure facilities. Below, some of the key findings are briefly summarized.

4.1. Proactive risk communication

The importance of proactive risk communication on CCS was identified by several researchers in recent years (Ashworth et al. 2010; Bradbury 2012; Brunsting, de Best-Waldhorber et al. 2011; Oltra et al. 2012; Terwel, Ter Mors, and Daamen 2012). As Kirsty Anderson, the former Communication and Knowledge Share Manager at Scottish Power, persuasively argued with regard to the proposed Longannet CCS Project:

> The benefit of our early consultation with trusted stakeholders was felt throughout the entire life of the project, but I don't want to give the impression that this approach is risk free … That is why we invested the effort in early engagement with responsible and influential representatives from these stakeholder groups – we didn't need everyone to publically endorse our work, but we wanted to ensure that we minimized the risk of misinformation and fear being spread (Anderson as referenced in Prangnell 2013, 38).

Equally important to early stakeholder involvement is engaging in well prepared communication. One needs to have the story completely clear and backed up by facts before engaging with stakeholders. In addition, researchers point out by involving stakeholders early on in the formal decision-making process; then, the issue of procedural fairness is addressed (Bradbury et al. 2009).

4.2. The importance of trust

Researchers working on CCS communication have also identified the importance of trust, noting that in many cases local stakeholders, such as community groups or even a town mayor, have more public trust than the developers (e.g. Reiner and Nuttall 2011; Terwel, Ter Mors, and Daamen 2012). Similarly, some researchers suggest that CCS developers should partner with credible partners such as environmental NGOs in order to put forward messages that are deemed as believable (Ashworth et al. 2010; Carr et al. 2010) as citizens will believe NGOs more than industry especially with regard to environmental risks and benefits (Oltra et al. 2012; Ter Mors et al. 2010; Ter Mors, Terwel and Daamen 2012).

4.3. Role of transparency

Some researchers point to the importance of being transparent about the costs and benefits associated with the CCS project in question (Brunsting, de Best-Waldhorber et al. 2011). Only by the developers or policy makers in question being transparent will publics and stakeholders with regard to the proposed CCS project will the public gain faith in what the developer is trying to do.

4.4. Role of educating the public with regard to CCS facilities

There seems to be a mixed view on how to best educate the public with regard to CCS, climate change and other related issues. A number of researchers point out the importance of developing education curricula which address these key issues so as to better inform the public (Ashworth et al. 2010; Colliver, Dowd, and Rodriguez 2011; Corry and Reiner 2011; Itaoka et al. 2012; Reiner 2008) as overall public understanding of CCS technologies remains low (Wallquist, Visschers, and Siegrist 2010), aside from areas where CCS facilities are being proposed (Pietzner et al. 2011; Terwel, Ter Mors, and Daamen 2012). This is seen as important as there are a number of intuitive misconceptions about CCS storage mechanisms which in turn can increase public perceptions of risks and at the same time decrease public perceptions of benefit (Wallquist, Visschers, and Siegrist 2010). That said, educating the public about CCS is not as straight forward as it seems.

Research shows that it is easier to inform publics about CCS and other technologies if they already have background knowledge than publics who have no knowledge at all (Terwel, Ter Mors, and Daamen 2012; Wallquist, Visschers, and Siegrist 2010). Similarly, by educating the public with regard to CCS facilities, this leads to more informed and consistent opinions on CCS, but does not necessarily lead to more positive or negative opinions about the technology (Brunsting, de Best Waldhober, and Terwel 2013; De Best-Waldhober, Brunsting, and Paukovic 2012). As Brunsting et al. argue:

> … more knowledge does not by definition lead to more positive perceptions about CCS. A higher score on correct statements about CO_2 significantly strengthens respondents' beliefs that CCS is not ready, that applying CCS will cause a lock-in for other technologies, that it will be too expensive, and may decrease property value (Brunsting, de Best Waldhober, and Terwel 2013, 7427).

4.5. The importance of social fit

There is no clear consensus amongst CCS researchers whether one should site a CCS facility where there are other noxious facilities. Dutschke points out that if a

community has experienced some form of successful underground storage facility in the past, the community will be more willing to accept a CCS facility (Dütschke 2011). Others point out, however, if one certain area already has enough noxious facilities, then siting a CCS facility in the same area may push the community over the edge leading to increased public opposition (Fleishman 2009; Hammond and Shackley 2010; Terwel, Ter Mors, and Daamen 2012).

4.6. Communicating about CCS projects

Researchers agree that accurate visual communication is preferable to written communication only (Brunsting, Upham et al. 2011; Mayer, Bruine de Bruin, and Morgan 2014; Wallquist, Visschers, and Siegrist 2010). In many cases, the public may over- or underestimate the size of buildings, chimneys or even the depth of CO_2 injection (Brunsting, de Best-Waldhober, Brouwer et al. 2013). As Brunsting et al note:

> We cannot assume that people correctly interpret a chart or diagram, whether or not to scale. Charts and diagrams are suitable to demonstrate the technical process to people, but visualizing how deep CO_2 is stored in a way that people will understand is difficult. (Brunsting, de Best-Waldhober, Brouwer et al. 2013, 7326)

In addition, any message developed needs to be correctly framed so as to ensure that issues of small probability of CO_2 leakages are set in proper context (Wallquist, Visschers, and Siegrist 2010), and there is a continued need to systematically review the range of communication materials already developed and test their usefulness using focus groups with a range of participants (Ashworth et al. 2010).

5. CCS risk communication-future research avenues and practical suggestions

Based on the earlier research findings from the core risk communication literature, there are clear overlaps. The risk communication literature identifies trust as a key variable in explaining public acceptance of risk. Some studies indicate that trust can explain up to 50 per cent of public perception of risk (Löfstedt 2005; Slovic 1993). Trust is also a key variable in the CCS communication literature. Similarly, CCS researchers argued for the importance of proactive communication and involving publics and key stakeholders early on in the siting process, something that has been discussed at length in the broader risk communication/siting literatures (Boholm and Lofstedt 2004). The importance of transparency has also been discussed both in the broader risk communication literature (Fischhoff 1995) as well as in the CCS area. This analysis suggests that CCS siting and communication researchers have drawn on some of the findings of the broader risk communication and siting research. That said there are some variables from the risk communication literature that have not been highlighted in enough detail in the CCS siting/communication research. This final part of the study looks at some of these key risk communication variables in more detail.

The lessons from risk communication and CCS communication literatures suggest that there is the potential for the technology to be effectively communicated to the affected parties. The research indicates that CCS is less dreaded and more familiar compared to nuclear power, for example. The biggest risk, that of carbon dioxide leakage from underground storage facilities, is considerably less dangerous than the

radiation risk associated with spent nuclear waste. That said, there is more to be done. Applying the following lessons from the wider risk communication literature could help the development of more effective public engagement and dialogue associated with CCS siting thereby helping to lead to the successful construction of these facilities.

5.1. *Engaging the local community as early as possible in the siting process*

This has been discussed at length in the broader risk communication and CCS literatures. It cannot be emphasized enough. Publics and stakeholders do not like surprises when it comes to siting issues (NRC 1996; Short Jr. and Rosa 2004). The question remains how to best engage the local community. It is not enough to simply encourage public engagement and then expect it to work (Petts 2004). Rather developers, regulators and policy makers need to be creative as possible and use examples from different settings. One set of useful guidelines come from the siting and building of Biosafety Level 4 (BSL-4) laboratories in Canada and United States, which was perfected by Lee Thompson and colleagues at the BSL-4 laboratory in Winnipeg, Manitoba (see Löfstedt 2002 for a full discussion). The key recommendations emerging from this study included:

- Proactive communication: informing the public of practically everything that occurred at the facility in question no matter whether it was a major or trivial issue. The Winnipeg team took the view that any perception of covering up information would lead to distrust whilst full disclosure would lead to trust.
- Focus groups: used to try and understand the key issues that stakeholders and the public were concerned about. Thompson set up three segmented groups: one made up of the local community; one of opinion leaders and the media; and a third by Health Canada's own scientists.
- Heavy emphasis on show and tell: Thompson and his colleagues were aware that BSL-4 facilities were exotic and therefore unfamiliar to the public. As a result, publics who expressed concern about the BSL-4 facility in Winnipeg were asked to participate in tours before the laboratory became operational.
- Identifying potential questions: Thompson and colleagues tried to identify in advance the types of questions that could come up at meetings and the responses to these. Based on their brain storming sessions, a potential source of questions was identified as films or television programmes focusing on dangerous pathogens such as Ebola. The researchers watched some of these films, including Outbreak (starring Dustin Hoffman), and based on them prepared possible hostile questions and responses. This worked very much to their favour as in the public meetings the local residents repeatedly asked questions based on these types of programmes and the staff came across as well prepared.
- Staff trained in risk communication. in order to respond effectively to public concerns, Thompson advocated that staff needed risk communication training. Several staff received such training, and they became a resource for others to draw on.

The success in siting and building the Winnipeg BSL-4 laboratory resulted in the communication model used there being replicated for BSL-4 facilities being built

elsewhere, including at the University of Texas Medical Branch Galveston, Texas, a new BSL-4 facility in Lubbock, Texas, and at the Karolinska Institute in Stockholm, Sweden (Löfstedt 2002).

These lessons on BSL-4 siting are relevant for the CCS sector. For example, CCS facility developers would benefit from engaging with local media at an early stage to build trust and understanding before the siting process begins. Similarly, developing proactive communication strategies and providing 'tours' of CCS facilities (even virtual ones) can help to make the public more familiar with a facility which, in turn, increases acceptability.

5.2. CCS facilities and social amplification

As discussed, social amplification of risk is a commonly used framework in the risk communication literature (e.g. Lofstedt 2008; Pidgeon, Kasperson, and Sloviv 2003), so it is surprising that CCS researchers have not drawn on it more to help explain why the siting of some CCS facilities have failed. The framework helps explain why some minor risks, in the eyes of the experts, elicit strong public perceptions, in many cases which have been amplified by media and social media networks. The framework could have been employed, for example, to help explain why the proposed facility at Barendrecht, Netherlands, was never built (Feenstra, Mikunda, and Brunsting 2010) and why the Vattenfall CCS facilities at both Beeskow (Dutschke 2011) and Janschwalde (Prangnell 2013) were unsuccessful.

5.3. The importance of familiarity

Familiarity is a key risk perception variable (Fischhoff et al. 1978; Slovic 1987, 2000) and highly relevant to the CCS area. Risk perception research has shown that individuals are more concerned about unfamiliar risks than familiar ones as they are concerned about the 'unknown'. This explains why tours of proposed CCS sites, displays about CO_2 pumping and storage, and material showing how CO_2 is transported, help in siting. Familiarity also explains why it is easier to build a waste tyre incinerator in Wolverhampton, which already has a number of similar facilities, than in Guildford which does not (Lofstedt 1997). A further example is that new nuclear reactors being planned for the UK will be sited at existing nuclear sites as both the workers and the local communities there are already much more familiar with the technology than others elsewhere. The same is true for the US if any new nuclear reactors are ever built in that country. Dutschke also demonstrated this with the limited public opposition to a CO_2 Sink project in Ketzin, Germany. The town itself had a facility producing town gas as well as a natural gas pipeline and an underground reservoir to stock natural gas (Dütschke 2011).

5.4. The role of culture

The role of identity and place is a crucial component with regard to siting facilities, such as CCS plants. Local communities are products of geographical, cultural and historical conditions. Past studies by geographers, sociologists and social anthropologists show how place and the landscape are important symbols in helping to build social identity (e.g. Bender 1993; Firey 1945; Lovell 1998). The concept of local identity itself helps researchers to understand how members in an affected local

community may respond to siting a facility (Boholm and Lofstedt 2004). Large-scale facilities may change the local landscape and significantly affect local identity (Devine-Wright 2009). Memories, scenery and certain landmarks may be destroyed if a facility is built. This means that a proposed large-scale facility may not necessarily be the subset of rational cost benefit estimates, local jobs for the community or the like. Rather:

> From a perspective that takes account of the cultural value of place and its singular and irreplaceable values (Kopytoff 1986), local reactions of protest, such as NIMBY-ism can be regarded as rational responses to large-scale technologies that intrude, spatially and culturally, on accustomed ways of life (Hornborg 1994; Mairal Buil, Bergua Amores, and Puyal Espanol 1997). (Boholm and Lofstedt 2004, xxi)

The role of social anthropology and geography appears to be under explored with regard to the siting of CCS facilities. Social anthropological studies in Barendrecht or Janschwalde could help identify significant reasons for public opposition.

5.5. *Better sharing of knowledge*

This article suggests that there is a certain disconnect between researchers who study CCS communication and the broader risk communication field. This means that researchers working on CCS sitings are not drawing enough on the lessons from other siting cases. Addressing this disconnect would require effort and engagement from a range of researchers active in both areas. This could be achieved by a special edited journal issue examining the broader siting literature or an international conference. Ideally, such a conference should be held in a country that has a direct policy interest in the development of a successful CCS facility such as Germany, Netherlands, Norway or the UK. As time is arguably running out for the future of CCS in Europe based on the lack of success stories, such a conference should be held sooner rather than later.

5.6. *Practical recommendations for CCS developers*

Coming out of the risk communication literature, there are also a number of practical suggestions for CCS developers.

5.6.1. *Focusing on key CCS facilities*

Ideally communication efforts on CCS must be based on some form of planning certainty. It does not make much sense to invest time and effort developing a proactive communication strategy for a CCS facility that the developer is then forced to drop for financial or other reasons not linked to the planning process as this will lead to public distrust of the developer. Hence, it is crucial to have good links with local and national policy makers, the local media, opinion formers and have funding secure before the siting process begins, as was the case with the BSL-4 facility in Galveston (Löfstedt 2002). There have been too many examples of CCS facilities that have been planned only to see the funders or policy makers abandoning them late in the siting process (e.g. Longannet, UK).

CCS developers must also realize that those who campaign against a local development have more time on their hands than either the average member of the public or any proponent of the facility (Prangnell 2013). Many opponents of noxious

facilities are students, house men/women, or pensioners rather than those in full time employment (see Löfstedt 2005 for an example). Those seeking to site CCS facilities therefore need to target and pursue those projects with a higher likelihood of success.

5.6.2. *Offshore vis-a-vis Onshore storage of CO_2*

Studies have shown that the public are more concerned about storing CO_2 underneath their homes or nearby than under the ocean sea bed (e.g. Fleishman 2009). This is to be expected as people see the 'threat' as close by, and they are concerned that CO_2 could 'leak' out and harm them or the environment. They may also worry that the pumping activity will affect their house prices. The Dutch ROAD CCS project is an example of this. Located near Rotterdam (but in an industrial area) and only 50 km away from the failed Barendrecht CCS site, considerable public opposition to the proposed facility could be expected. Instead there was little opposition to speak of primarily because the CO_2 would be stored offshore rather than onshore. As Mark Kombrink, a representative for the ROAD project, argues:

> Of course, the big advantage we had was that we plan to inject and store the CO_2 offshore so we can immediately avoid the claims that were being made about the sites at Barendrecht, where there were crazy claims about the risks of the gas seeping under people's homes and so on. That gave us a head start … (Kombrink 2013, quoted in Prangnell 2013, p. 43)'

This suggests that offshore CO_2 storage facilities will be much easier to site than onshore ones, although it will be considerably more expensive to do.

5.6.3. *The role of local ownership*

Some form of local ownership of the CCS facility could also aid in the siting of the facility. Studies have demonstrated that when the public and stakeholders are offered part ownership of a facility and then buy shares in it, they will be more supportive of the facility and trusting of the developers (Schelling 1960). This is also associated with fairness. By being offered part ownership of a facility those affected by it will perceive that the benefits and risks are being shared with the developer. There is much less public opposition to wind farms in Scandinavia than in Scotland or Wales, for example. A major reason for this is that in Scandinavia, the developer is often the local municipal utility company which is de facto owned by the citizens in that municipality and, hence, any wind farm being built there will directly benefit the local citizens in terms of green energy. Such local municipal energy companies do not exist in Scotland and Wales by and large, and in most cases, there the developers of wind farms are large multinational utility companies such as Vattenfall who do not share the benefits and the risks of these wind farms with the local populations. Going forward, CCS developers could consider offering part ownership in their facilities to local affected public.

6. Conclusion

Siting and building of CCS facilities in Europe continue to be challenging. A key reason for these siting failures is poorly thought through or incomplete risk communication strategies. This study makes a number of theoretical and practical

recommendations which are designed to assist the wider CCS community in developing more robust siting and risk communication strategies. Action is needed to be taken now. Examining Fischhoff's evolution of risk communication (Fischhoff 1995), it is clear that in comparison to a number of other sectors such as chemical plant siting, CCS communications have not gone through more than arguably the first four stages. This is crucial as with the catalogue of siting failures in Europe, policy makers, regulators and developers are reconsidering investing in the siting and building of CCS facilities. This should not be the case. We in the risk communication community should work with the CCS community on helping to achieve a successful siting of a commercial CCS facility in Europe. If the science associated with the technology is communicated appropriately (e.g. Fischhoff 2013) and if concerned publics and stakeholders are involved at an early stage of the siting process and are offered part ownership in the facility, this should be eminently feasible, but to get there more work needs to be done.

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