COMMUNICATING THE RISKS OF CCS

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Part 1. Introduction

Carbon dioxide capture and storage (CCS) is a technology that can be used to reduce greenhouse gas emissions into the Earth's atmosphere. The technology has applications across multiple industries including the oil and gas industry where it is applied in the enhanced oil and gas recovery (EOR) process. CCS involves three primary steps: (1) capturing carbon dioxide (CO_2) at large point sources; (2) transporting the CO_2 to a suitable location; and, (3) injecting the CO_2 into deep geologic formations for permanent storage. Each of these steps is based on technologies that are used in other industrial applications. Although there are not many instances where CCS has been integrated for large scale use, there are numerous pilot projects and a growing number of larger-scale projects that are being used to develop and demonstrate CCS.[1] As these projects increase in scale, and CCS becomes a commercially viable CO_2 reduction strategy, concerted effort has gone into systematic risk assessment and mitigation for CCS projects. The International Energy Agency Greenhouse Gas program (IEAGHG) sponsored the development of a database of more than 200 generic features, events, and processes (FEPs) potentially associated with CCS projects.[2,3] The FEPs' focus on the behaviour of CO_2 is with respect to the long-term performance and safety of CCS projects. The database is organised around eight categories of risk based on "technical and scientific considerations."[4]

There are, however, other ways to view project related risk. First, from a business perspective, a company with several options for developing energy generation assets and/or climate change mitigation strategies may opt to not go forward with an otherwise good CCS project simply because it does not perform as well financially as an alternative option or project. Second, from a social perspective, people in a community in which a project is planned may consider these risks more broadly, including not only the technical and scientific risks, as developed through something like a FEPs-based risk analysis, but also their own perceptions of these risks and how the project fits into their overall views of the community. The support or opposition such perspectives engender can have substantial impact on project cost and viability.

Understanding the way in which people evaluate project risks is a topic that has been studied extensively in the social science literature, and we are now gaining direct experience from early CCS projects. This report aims to provide the reader with a better understanding of what we have learned about the ways in which people view risk more expansively than just a technical and scientific assessment would indicate and the importance of addressing this view. The report builds on previous work completed for the Global CCS Institute (The Institute) including a Communication/Engagement Toolkit for CCS Projects[5] and a Social Site Characterisation Toolkit.[6] It is intended to assist those involved in the planning and implementation of CCS projects to develop more effective and productive stakeholder engagement programs.

Following this introduction, Part 2 of the report reviews the theoretical underpinnings for an approach to risk communication. For Part 3, the authors interviewed representatives from five CCS projects to review project experience in risk communication and summarise lessons learned from those experiences. Based on these lessons, the authors suggest, in Part 4, an iterative five-step strategy for learning how the community views the project and for developing effective risk communication programs. This final part also provides the reader with a series of pointers and resources for use in developing risk communication programs.

Part 5 concludes with a brief summary of lessons learned and makes suggestions for further research.

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[1] Global CCS Institute, The Global Status of CCS: 2010, (2011), Canberra, Australia.

[2] IEAGHG, Risk Scenarios Database:http://www.ieaghg.org/index.php?/20091223132/risk-scenarios-database.html

[3] Savage, D., Maul, P., Benbow, S., and Walke, R., "A Generic FEP Database for the Assessment of Long-term Performance and Safety of Geological Storage of CO_2," Quintessa, June 2004, (http://www.ieaghg.org/docs/QuintessaReportIEA.pdf)

[4] IEAGHG Risk Scenarios Database: http://www.ieaghg.org/index.php?/20091223132/risk-scenarios-database.html

[5] Ashworth, P., Bradbury, J., Feenstra, C.F.J. (Ynke), Greenberg, S., Hund, G., Mikunda, T., Wade, S. and Shaw, H. (2010). Communication/Engagement Toolkit for CCS Projects, CSIRO: EP105893, prepared for the Global CCS Institute. Online at: http://cdn.globalccsinstitute.com/sites/default/files/publication_20110601_communication-engagement-toolkit.pdf

[6] Wade, S., Greenberg, S., Social Site Characterisation: From Concept to Application, CSIRO, (2011).

Part 2. Theoretical underpinnings

Support or opposition to new technology by members of the public can be influenced substantially by their perceptions of the risks and benefits of a technology and how they perceive it will impact their lives. Those involved in CCS, including project developers, regulators, elected officials, civic groups and others, all have an interest in understanding how the public will perceive the benefits and risks of CCS generally and in relation to specific projects. Social science research provides insight as to how these perceptions are formed.

As a relatively new technology, there is some uncertainty about the cost and performance of CCS. Further, it is a technology where many of the benefits accrue to a larger public while the potential risks are concentrated in a local area. Indeed, there are a few cases where strong public opposition to proposed projects has played a factor in preventing those projects from being implemented. Yet, in other cases, CCS projects enjoy solid public support.[7]

Developing an understanding of how people view CCS technology can, in turn, help in developing effective programs for risk communication. This is important because it is the basis for working with the public to develop projects. As Fischhoff has stated:

> *"Effective risk communication can fulfil part of the social contract between those who create risks (as a by-product of other activities) and those who bear them (perhaps along with the benefits of those activities)… A complex network of mutually respectful relationships may offer the best hope of reaching agreements, when they are there to be had. It must, however, be recognised that avoiding all conflict is not a realistic, or even a legitimate, goal for risk communication. It should not and, in an open society, often cannot paper over situations where people are getting a bad deal.* ***The best-case scenario for risk communication (and, indeed, risk management) is having fewer, but better conflicts****. Some conflicts would be avoided by preventing needless misunderstandings, others by forestalling (or redesigning) unacceptable projects."*[8] *(Emphasis added)*

2.1 What do we know about how people perceive the risks of technology?

Studies of public response to new technologies have focused primarily on perceptions of risk. Initially, much of this work, some over 30 years old, was applied to understanding public response to nuclear power. The findings, which have been applied to other new technologies such as genetically modified foods and food irradiation, are also helpful in approaching CCS. Although there are variations, including evolution and blurring of the practical applications over time, two basic "ideal types" of risk perception approaches can be distinguished: (1) the psychometric; and, (2) the social. The former focuses on characteristics of the technology; the latter focuses on the social context, including the context of both the public perceiver and the producer of the risk analyses.

2.1.1 The psychometric approach

Lead researchers in this school include Paul Slovic and Baruch Fischhoff. Their studies, originally conducted in the late 1970s and 1980s, presented the Psychometric Paradigm – a form of cognitive map of lay persons' risk perceptions. The studies identified two main factors used by the lay public to evaluate a hazard: (1) the Dread factor; and, (2) the Unknown factor. See Figure 1.[9]

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[7] Ashworth, P., Bradbury, J., Feenstra, C.F.J. (Ynke), Greenberg, S., Hund, G., Mikunda, T., and Wade, S. (2010a). *Communication, project planning and management for carbon capture and storage projects: An international comparison*. Prepared for Sarah Clarke, Global Carbon Capture and Storage Institute. CSIRO: EP104273.

[8] Fischhoff, B., Risk Perception and Communication Unplugged: Twenty Years of Process, Prepared for Addressing Agencies ' Risk Communication Needs: A Symposium to Discuss Next Steps, Annapolis, MD, June 6-8, 1995.

[9] Slovic, P., Perception of Risk, *Science*, Vol. 236, 1987.

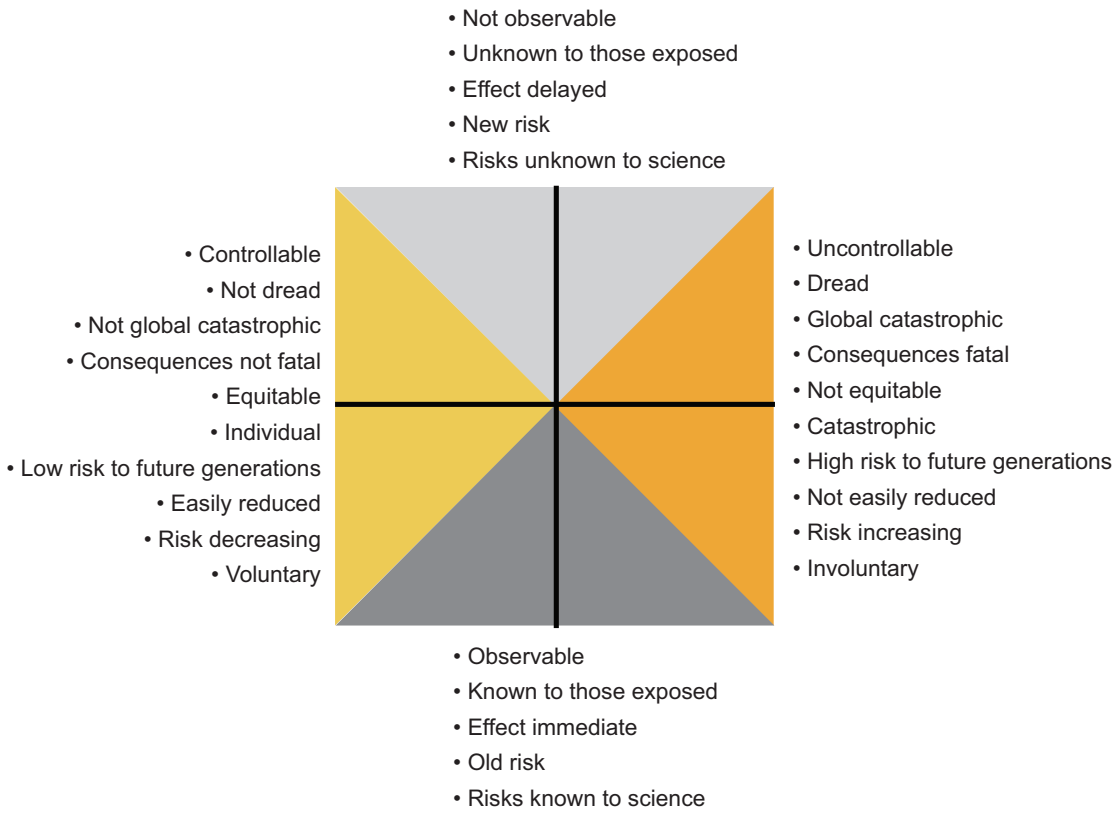

Figure 1. Factors Considered in Assessment of "Riskiness"

The essential conclusion of this work was that whereas technical experts tend to measure risk in terms of quantitative impacts such as mortality, lay people tend to consider additional factors, such as those in Figure 1, in their assessment of risk.[11]

As initially presented and interpreted, these technical assessments treated risk as an objective reality against which "faulty" or "inaccurate" public perceptions could be measured.[12] Further, the "fact that perceptions of risk are often inaccurate, points to the need for warnings and educational programs."[13] The early work of the psychometric school was enormously influential – and also congruent with the thought processes of technology developers who were seeking to explain, understand and address the apparent misunderstandings of the public. Accordingly, risk communication "was seen as the answer to many thorny problems – most notably as a means to bridge the gulf between expert views and public perceptions of risk."[14]

The psychometric approach evolved over time to take into account broader issues such as trust and equity and to recognise that the judgement of experts as well as the lay public may be subject to bias. In particular, recognition was given that "there may be wisdom as well as error in public judgements" and that "risk communication and risk management efforts are doomed to fail unless they are structured as a two-way process."[15] Further, Slovic acknowledged the inherently subjective element in risk assessment as evidenced in his statement that:

[10] Slovic, op. cit., 1987, p. 282

[11] Slovic, op. cit.,, 1987, p. 282.

[12] Slovic, P., B. Fischhoff, and S. Lichtenstein. Rating the Risks. *Environment*. 21(3): 14-39, 1979.

[13] Slovic, P., "Informing and Educating the Public About Risk," *Risk Analysis* 6: 403-415, 1986, p. 405

[14] Krimsky, S., D. Golding, eds. Praeger, "A Social and Programmatic History of Risk Research," in *Social Theories of Risk*, Westport, Connecticut, 1992, p. 43.

[15] Slovic, op. cit., 1987, p. 285.

> *"One way in which subjectivity permeates risk assessments is in the dependence of such assessments on judgments at every stage of the process, from the initial structuring of a risk problem to deciding which endpoints or consequences to include in the analysis, identifying and estimating exposures, choosing dose-response relationships, and so on."*[16]

Additional research, in which Kasperson took the lead role, highlighted the way in which risk events could be amplified or attenuated by social processes as they were filtered through "amplification stations" that could include individuals, scientific and social institutions and the media. This process, acting like a stone thrown into a pond, could result in secondary or tertiary ripples such as heightened public concern and controversy and market impacts on products and prices.[17]

More broadly, Fischhoff has summarised the evolution of risk communication practice from the perspective of the psychometric school as a series of approaches that ultimately come full circle as indicated in Figure 2.

Subsequent research, in which Fischhoff played a role, utilised the "Mental Models" approach, which focuses on risk communication. Mental models are deeply, and typically unconsciously, held internal images of how the world works that serve to constrain the way people think and act. Although not directly part of the original psychometric approach, this research also took as its starting point the factors identified in Slovic's map and a "commitment to the scientific facts of risk."

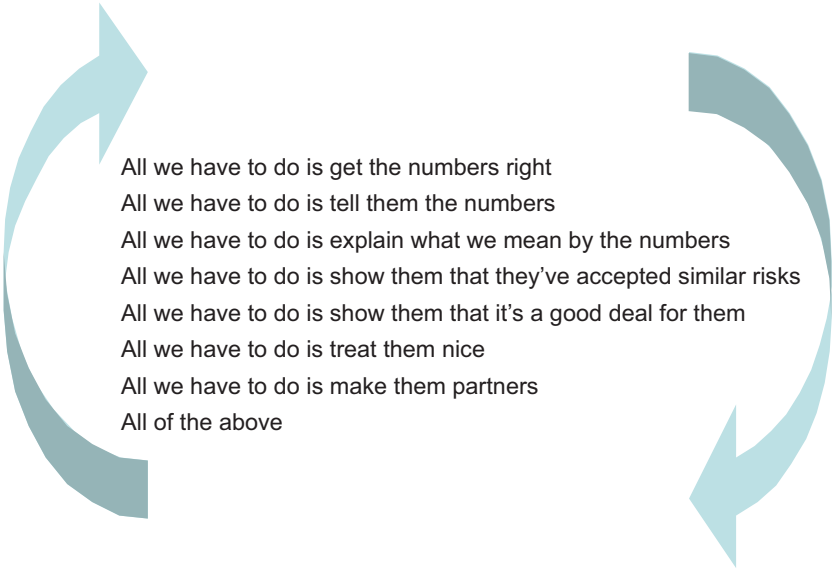

Figure 2. Developmental Stages in Risk Management (Ontogeny Recapitulates Phylogeny)[18]

The approach emphasises the interpretive dimensions of risk communication:

> *"[People] need a diverse set of cognitive, social and emotional skills in order to understand the information they receive, to interpret its relevance for their lives and communities and articulate their views to others."*[19]

Morgan et al. outline five key steps in creating and testing risk messages "in a way that is faithful to science and communication."[20] The first step involves creating an expert concept. As a second step, mental model interviews are conducted with lay persons to elicit their beliefs about a hazard, expressed in their own terms, followed by structured, confirmatory questionnaires that are administered to appropriately sampled lay groups. Fourth, using the results from the interviews and questionnaires, researchers compare lay and expert models to identify where there are differences, and then finally, fifth, draw up risk communication messages to address incorrect beliefs and knowledge gaps that need to be filled.

[16] Slovic, P., E. Weber, Perception of Risk Posed by Extreme Events, Conference Paper from "Risk Management Strategies in an Uncertain World," Palisades, New York, April 2002, p. 5.

[17] Kasperson, J.X., R.E. Kasperson, N. Pidgeon, and P. Slovic, "The Social Amplification of Risk: Assessing 15 Years of Research and Theory," in Pidgeon, N., Kasperson, R.E. and P. Slovic, in *The Social Amplification of Risk*, Cambridge University Press, 2003.

[18] Fischhoff, op. cit., 1995, p.138

[19] Morgan, M.G., B. Fischhoff, A. Bostrom, and C. Atman eds. *Risk Communication: A Mental Models Approach*, Cambridge, Cambridge University Press, 2002, p. 2.

[20] Ibid., p. 20.

The draft risk communication messages are then subjected to expert review to ensure their accuracy before delivery to specific groups.[21]

Much of this work in risk communication has been applied to communicating information to potentially affected individuals on health and safety risks related to radioactivity and/or health issues such as AIDS, where the risk information is based on well understood statistics. However, recent studies have applied the mental models approach to CCS in order to assess public attitudes to energy options and technology in the abstract rather than in the context of a specific facility in a specific location.[22,23]

2.1.2 The social approach

In the 1980s and 1990s the psychometric school was challenged by social theorists on the grounds that the approach ignores the social context in which knowledge is produced, interpreted and used. This school highlighted the social processes within which opinions about a particular issue are formed: people (including developers and their technical experts, as well as the potentially affected public) do not evaluate technology such as CCS in isolation from their broader life experiences and social affiliations. Rather, they base their evaluation on an existing cultural frame of reference – their values, interests, and ways of interpreting and responding to the world. In short, this school of thought started from the social background and characteristics of the perceivers rather than from characteristics of the technology, as was the case for Slovic, Fischhoff, and associates.

The primary contributions of this school were three-fold. First, building on work in the sociology of science and earlier work by the sociocultural pioneers Douglas and Wildavsky, proponents of the social approach disputed the so-called objectivity of risk.[24] They emphasised, as Slovic himself stated in his later work, that the process of risk identification and estimation involves the analyst's judgment – hence, the process can never be value-free. Treating risk as an objective "fact" is inaccurate and leads to misleading guidance for interactions with the public. As Wynne has emphasised, such an approach encourages adoption of the "deficit model" of risk communication which assumes that the nature of the problem is related solely to the need to redress a lack of scientific information on the part of the public.[25]

A second contribution was their explicit recognition that attempts to make technology decisions on the basis of technically-defined risk fail to incorporate the full societal dimensions of the policy issues at stake – a point emphasised by Funtowicz and Ravetz as being of particular relevance for policy problems where both factual and evaluative dimensions are high.[26] Otway,[27] for example, pointed out that opposition (or support) of technologies, which may be caused by factors that go beyond risk and also beyond other characteristics of the technology, include social and economic issues that are quite separate from risk. Further:

> *"The risk perception paradigm acts to reinforce the technical definition of risk to the exclusion of the many non-risk attributes that underlie public perceptions of the technologies or activities that create the risk. Risk is not accepted in the abstract; it is only part of the package of attributes that people must accept when they accept, for example, a technology that causes a risk. Risks are not sited; technologies or industries are. Perhaps the only time that nothing but risk is being "perceived" is when respondents are filling out a risk questionnaire."*[28]

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[21] ibid., p. 20.

[22] Palmgren, C., M.G. Morgan, W. Bruine de Bruin, and D. Keith, Initial public perceptions of deep geological and oceanic disposal of carbon dioxide. Environmental Science & Technology, 38, 6441-6450, 2004.

[23] Fleischman, LA., W. de Bruin, and G. Morgan, "Informed Public Preferences for Electricity Portfolios with CCS and Other Low-Carbon Technologies," *Risk Analysis*, 30 (9): 1399-1410, 2010.

[24] Douglas, M., and A.Wildavsky, *Risk and Culture*, University of California Press, 1982

[25] Wynne, B., Public Engagement as a Means of restoring Public Trust in Science – Hitting the Notes, but Missing the Music? *Public Health Genomics*, 9: 211-220, DOI: 10.1159/000092659, 2006.

[26] Funtowicz, S.O., J.R. Ravetz, Three Types of Risk Assessment: A methodological analysis, in *Risk Analysis in the Private Sector*, eds C. Wipple and V. Covello, Plenum, New York, 1985.

[27] Otway, H., D. Winterfeld, "Beyond Acceptable Risk: On the Social Acceptability of Technologies," *Policy Sciences* 14:247-256, 1982.

[28] Otway, H. and K. Thomas, Reflections on Risk Perception and Policy," *Risk Analysis* 2: 69-82, 1992., p. 233.

In part, technology decisions are essentially ethical questions about the level, acceptability, and distribution of risk.[29] In part also, these decisions include the political dimension of how to proceed in a democracy when there is a discrepancy between "what the experts deem important and what the public demands from its government."[30] Finally, and perhaps most significantly, these decisions overlook the element of public trust in the agencies/organisations which are responsible for managing the risks of a technology. As Wynne has emphasised, knowledge is conditional: validity is dependent on conditions embedded in a particular knowledge model being fulfilled in actuality. The experts' trust in the role of supporting institutions in managing the inevitable uncertainties of technology deployment (in itself an integral part of the risk) may not necessarily be shared by the public and this is key to understanding public perception of the risk of a technology.[31,32]

Thirdly, in their examination of the history of risk communication as one which had emerged from a context of political conflict, Plough and Krimsky reoriented the expert-lay divide into a more productive focus on the differing rationalities underlying judgments. They term these the "technical rationality" and the "cultural rationality" and point out that "cultural rationality does not deny the role of technical reason; it simply extends it." Further:

> *Technical rationality operates as if it can act independently of popular culture in constructing the risk analysis, whereas cultural rationality seeks technical knowledge but incorporates it within a broader decision framework.… Researchers who view the difference between popular cultures and technical rationality as a form of deviance are not likely to generate better strategies for risk communication.*[33]

Finally, this approach pointed to the active role of participants in communication rather than as passive recipients of technical information. As Otway notes, "the goal of communication is not information but the quality of the social relationships it supports. Risk communication is not an end in itself; it is an enabling agent to facilitate the continual evolution of relationships."[34] This viewpoint is also underscored by Rayner who points out that information transmission is only one part of communication, which "also involves developing shared meanings among individuals, institutions and communities and establishing relationships of trust."[35]

2.2 What are the implications for risk communication concerning CCS deployment?

Several insights can be derived from the previous studies discussed in this section.

First, a more expansive view of project risk is warranted. Given the prominent role of technical experts and scientists in CCS, there is a natural tendency to focus on the technical or scientific risks from CCS using probabilistic assessments to determine their materiality. Yet we know that there is inherent subjectivity in these assessments. And, we also know that the public considers a broader range of factors in their assessment of project risks. Frequently the risks as assessed by experts and lay people are contrasted as "real" and "perceived;" terms which imply that the more expansive perception of risk is somehow irrational or inaccurate. A more productive approach to addressing this is to recognise that risk includes both technical and non-technical elements.

Second, simply providing more and better risk information in an attempt to "educate" the public is in itself insufficient to address the full scope of public questions surrounding technology. The public is not a passive "target audience" to whom messages should be delivered but rather is an active participant in interpreting information. Ideally, the directly affected public should be a partner in a two-way process that involves information sharing and relationship building.

Third, differences in perceptions of risk are not limited to differences between experts and the public. The public is more accurately characterised as constituting different "publics" whose differences should be taken into account in developing risk

[29] Rayner, S., R. Cantor, "How *fair* is safe enough?" *Risk Analysis*, V. 7(1):3-9, DOI: 10.1111/j.1539-6924.1987.tb00963.x, 1987.

[30] Plough, A., S. Krimsky, "The Emergence of Risk Communication Studies: Social and Political Context," *Science, Technology and Human Values*, Vol 12 (3-4), 1987, p.7.

[31] Wynne, B., "Knowledge in Context," *Science, Technology and Human Values*, V. 16 (1), 1991.

[32] Wynne, B., "May the Sheep Safely Graze: A Reflexive View of the Expert-Lay Knowledge Divide," in *Risk, Environment and Modernity*, S Lash., B. Szersrynski and B. Wynne, eds., London, Sage, 1996.

[33] Plough and Krimsky, op. cit., page 4

[34] Otway, H. and K. Thomas, op. cit., 1992, p. 227.

[35] Rayner, op. cit., 1992, p. 85.

communication. Further, in addition to seeking to understand how members of the public perceive the risks of technology, it behoves developers and their technical staff to develop a greater self-awareness and acknowledgement of the uncertainties and limitations of technical risk assessments and the uncertainties involved in deployment and regulation of a new technology, as well as a need to address the broader, legitimate concerns of the public.

Finally, and most particularly, a more productive approach may be to address issues of technical or scientific risk as only one component of project risk. The essential issue is not technical risk per se but the overall potential impact of a technology on host communities, including, in particular, the perceived trustworthiness of the agencies responsible for managing and taking care of unforeseen occurrences. Risk communication would therefore be structured more broadly than discussions about technical risk. It would also include discussions with the affected public about their perception of the distribution of risks, benefits, and other deployment issues. In effect, risk communication becomes an integral part of the overall stakeholder engagement process.

Part 3. Experience in risk communication from CCS projects

For this section of the report, the authors interviewed representatives from five major CCS projects located in the United States (U.S.) and Canada: the Illinois Basin-Decatur Project, Mountaineer, Quest, and Weyburn projects, as well as the several projects conducted by Southern Company including Plant Barry and Plant Daniel. The purpose of the interviews was to survey the group to gain an understanding of the basic approaches to risk communication and to gather insights developed through project experience. These projects were selected as examples where, although the projects are not without challenges, the project team appears to be successfully working with communities to site and implement projects.

The interviews were conducted by phone and transcribed so that the team could accurately capture the impressions of the interviewees. The interviews consisted of eight general questions and one or two questions that probed specific events or conditions at each project (See Appendix A for the general protocol). The interview guide was designed to encourage a wide ranging discussion of risk communication efforts. What follows is a brief description of some of the pertinent characteristics of the projects, a summary of findings organised by five topic areas, and observations about lessons gained through the experience thus far.

3.1 Pertinent project characteristics

Certain characteristics are consistent across all or most of the interviewed projects and are worth noting.

- **Historic and economic ties:** In all cases, there was a strong tie between the project host and the local economy. In all except one of the cases, the company had been a major employer for many years, providing well-paid jobs and support to the local economy and tax base. And in all cases, there was an emphasis placed on communicating with company employees about the project. The project hosts tended to have been present and active in the community or nearby to the storage location well before the CCS project was initiated and often had other business efforts in the community. Notably, in two cases, the project host did not take the lead in conducting the CCS project but played a significant role in communications locally and with employees. In all cases, there was a strong sense that the project host had built up a reservoir of goodwill based on this past history.

- **Emphasis on community relations:** In four of the five cases, the project operator had significant experience working and communicating with local stakeholders. In four cases the project host had dedicated community relations staff who spent most of their time working with the local community on all issues related to the host company, not just CCS. In three cases, the project host had a community liaison specifically for the community in which the project was located. Two of the projects drew on previous experience in which concerns about risks associated with the host's activities became an important issue locally. In both cases, the interviewee described how the company had learned from these experiences and took seriously the potential that there would be significant concerns beyond the technically-defined risks from CCS.

- **Context:** In the project communities, the need for continued use of fossil fuels and the potential benefits of CCS essentially were not in dispute. In three cases, oil and gas activities were already taking place in the communities where storage projects were located and the project representatives reported that, consequently, local stakeholders

were familiar with the technical aspects of CCS. In the other two cases there was little experience with oil and gas operations but the local economy was dependent on coal-fired electric power produced by the company. In all five cases, the interviewees noted that there was not a strong call for addressing climate change, but there was community recognition that regulatory constraints on CO_2 that could affect their business and the local economy were likely in the future. Therefore, In three cases, the interviewees expected broader opposition to the use of fossil fuels but it did not materialise in a way that impacted project implementation.

- **Structure of the project team:** Three of the projects were primarily led by the host company and technical experts were brought in as needed. In most of these cases, the technical experts played a significant role but there was a sense that the host company was in charge. Two of the projects seemed to have a more collaborative approach in which the host was prominent and became involved in communication, but the technical experts had the primary role in conducting the project.

3.2 Findings

Topic 1. The nature of the host company's relationship in the project community

In all cases, the project team had a strong presence in the communities in which the source of CO_2 and the storage project were located (if they were different). The main characteristics included a long-term history of providing economic benefit to the community; demonstrated technical or implementation experience; and, a foundation of well-established, good employee and community relationships.

As outlined in the previous section, the company had been a major employer for many years, providing well-paid jobs and support to the local economy and tax base in all except one of the cases. The companies also had demonstrated experience in other industrial processes, as well as experience in managing potential risks or actual instances of the risks being realised in the community. As one interviewee emphasised:

> *"We're speaking from experience, we're learning by doing. OK? We're not just a university out there saying something theoretically where we've never been on a site where CO_2's being injected or where a well has been drilled or a capture plant is operating."*

Long-term community relationships were well established. In most cases, employees of the project team's companies live and/or work in the community where either the CO_2 is sourced or stored. The nature of these relationships was summed up by an interviewee from one of the communities where a plant was located: "So the plant has been a big part of the community and our company's been a big part of the community for quite a long time." Another elaborated as follows:

> *"We're already ingrained in the community. I always say this to everybody because I've found this to be the most important thing with our risk communications is [the community people,] are our employees… that work at these plants, you know there's hundreds of people that work at [our company], they all live in the local area around the plant. So we start internally addressing these people and the risks and that is both internal and external communications at the same time. We're addressing multiple stakeholders at one time because the employees are the local community around the plant."*

Topic 2. The extent to which the host company believes it is a trusted source of information on CCS

In all cases, the project teams believed that they were a trusted source of technical information on CCS. A variety of reasons were cited as evidence.

In one case, the company initiated broad public polling after an unrelated accident occurred at one of their plants almost a decade ago. They have used that polling to track their stakeholders' perceptions of the host company over time. The company sees this effort as just one component of larger efforts to open up lines of communication with their stakeholders, as well as using the polling to identify areas of potential concern.

In two cases, the companies believed that being viewed as a trusted source of information stemmed in large part from their role as an employer and their good relationships with employees, including a pattern of keeping employees updated on plant developments. They emphasised that [they] "build credibility in the community by doing the things that we're doing – to have the credibility to back up what we're saying because we are living and experiencing it." And another interviewee said:

> *"We have a good thing going to build public confidence in CCS because of our bigger picture attributes and things that we've done in the past and over time."*

One company representative stated:

> "*When we were awarded the site characterisation project… I would go in and they'd have all the plant employees come in and we would give a presentation on what we're doing. And be very open with them, and say OK, you all are going to be seeing some drill rigs coming onsite, you're going to be seeing some trucks hauling CO_2, you're going to be seeing contractors and stuff like that. So we try to start addressing stakeholders early on when things are happening and so we tend not to have anybody not understand what is being done – you know they'll ask a few questions, but then tend to view it as not a big deal, they're doing this for our benefit and we're listening to them and that sounds good and lets go back to our jobs."*

Another reported:

> *"Oh, I would definitely say we have a lot of credibility in the community. And it's probably because of our proactive position on communication. We – we're always trying to be at the forefront when new information comes out. If we're going to do a modification to the power plant, install new equipment or change the way we operate things, we try to lead into that with a lot of public outreach so that people are comfortable with what's going to happen before it happens."*

One team believed that they were a much-trusted source of technical information about CCS, primarily because of their broad experience with CCS projects and wide visibility with other CCS projects regionally. They also noted that public trust stemmed "from the type of organisation we work for" and that stakeholders expect them to play an objective role:

> *"We have the luxury of being creators of solid technical information and the interpreters of technical information into non-technical language... We are expected to be objective and that role has been very beneficial in terms of earning trust among the citizens."*

In addition, as the above statement indicates, the credibility of one team member may also serve to boost the credibility of the overall team. This process was emphasised by another interviewee who reported that the host company was extremely well respected and, they believed, lent credibility to their technical partner. In their words: "We brought in experts from… other sources and I think, because we trusted them, that made the community trust them more."

Yet another of the projects felt that their reputation was split. The media seemed to characterise them as not being impartial because of their role in funding research. However, at the local level in the project community, they felt that they were "viewed as offering effective information and an independent research program, that is, independent of the oil companies."

Topic 3. Assessing potential project risk

The interview guide did not include detailed questions about how the projects identified and assessed their project risks. However, in two cases, the process used to do this was described as part of the overall approach to risk communication – in the other three cases, risk assessment methods were not discussed per se and so are not reported here. In the two cases described below, the projects first conducted risk assessments internally, using technical experts. In addition, one project brought in external experts and/or stakeholders to participate in very structured risk assessment exercise and the other presented their findings in a workshop with external stakeholders in order to further assess stakeholder views on both technical and non-technical project risks.

The former project team described the link between risk assessment and risk communication as a focus on the nature of the project rather than on risks and benefits per se. This team made "listening a priority, talking to people one-on-one at

open houses, to understand how they view the risks and proactively addressing [those identified risks] by providing, through geologic explanations, why we think this process will work and why this reservoir is suitable." They did not have "a major risk discussion in the public sector really," however, early in the project, the project conducted a risk workshop with selected "proxy" stakeholders in which they elicited participant perspectives on a series of technical and non-technical risks identified through use of the IEAGHG FEPs database and other identified risks.

A member of this project team reported that they had found the assessment very useful; in part, because the findings were subsequently used as the basis for risk communication with the community. In addition, the process proved valuable internally in making "everybody involved in the project recognise the potential risks associated with public opinion."

This first risk assessment process involved a multi-tiered assessment in which participants rated the potential severity and likelihood of various risks individually and in small groups.[36] Throughout the assessment, participants had the opportunity to add new risks to the assessment. The project team invited a small group of stakeholders and experts representing an array of experiences. Based on the knowledge gained from this assessment, the project team committed resources and "used science" to develop "accurate analogies and visuals" that addressed the broad array of risks identified by the technical team and by the stakeholders "in a very serious, methodical way," that was "respectful and responsive to differing perspectives on risks." They were able to back up their assurances by pointing to recent geological work they had done and the suitability of the regional geology.

The second project reported that they conducted a risk workshop with community leaders "which resulted in positive feedback." The format of the workshop conducted by this project team differed from the assessment conducted by the other project. In this case, the assessment was primarily focused on risk identification. It was conducted in a day-long workshop involving presentations and group discussion. Some risks had been anticipated by the project team and it was expected that still others would be identified. During the interview, the project team indicated its plan to follow up with participants with a written report that was under development at the time of the interview. The report would specifically address the risks identified by stakeholders and reviewed in the workshop. For example:

> *"And so, arising from [a particular concern (e.g. CO_2 seeping into the bottom of lakebed)], even if that did happen [we will indicate] what would be the mitigation or what would be the effect [of the concern]. This is what is being written up so when we go back to the group we can say 'OK, here's what your concern was,' but – you know it's a one in 150,000 chance or one in a million chance. Here's the 'what if it did happen' [and what] would be done to mitigate it."*

Interestingly, although the participants were familiar with oil and gas operations (including EOR), the project team found that:

> *"It transpired that it was the first time that [the workshop participants] had heard about the research taking place and were very interested in learning the details. They were actually much relieved. Someone said, 'You can actually see where the CO_2 is in the reservoir?' And we said, 'Yes we can, we don't know in what concentrations, we haven't been able to develop that kind of a program yet.'*
>
> *So they were very positive because they were made aware of additional research that went over and above the regulatory rules of oil field development. And so that was actually a very good public relations exercise though that wasn't really the reason we were doing it. We were doing it as part of the risk assessments and they were very positive at the end of it."*

[36] This process is described in detail in several papers developed by Schlumberger Carbon services including:
(1) Hnottavange-Telleen, K., Krapac, I. and Vivalda, C. Illinois Basin-Decatur Project: Initial risk-assessment results and framework for evaluating site performance, Energy Procedia 1 (1) (2009), pp. 2431–2438.
(2) Hnottavange-Telleen, K., Chabora, E., Finley, R., Greenberg, S., Marsteller, S., "Risk management in a large-scale CO_2 geosequestration pilot project, Illinois, USA," Energy Procedia, Volume 4, 2011, pp. 4044-4051, 10th International Conference on Greenhouse Gas Control Technologies.
(3) Hnottavange-Telleen, K., From Decatur to Denver: Progress with information capture for CCS risk assessment. Presented at IEA GHG Risk Assessment 5th Network Meeting, May 2010. Available at http://www.ieaghg.org.
(4) Hnottavange-Telleen, K., "A 'FEPs" Approach to CCS Risk Assessment and Management," WETSCARB Annual Business Meeting, September 15-17, 2009, accessed online July 8, 2011 at: http://www.westcarb.org/pdfs_scottsdale/KenHnottavange-Telleen.pdf

Although the workshop was considered a success, the interviewee noted that a possible downside of this approach is:

> *"When you create situations… where you tell [stakeholders] to think about a potential risk and where it is, [and] what are the things they want to protect, then they start to worry. 'Well, maybe there is a potential for there to be a leak underneath this' and then they start to think about things… But, I think that if you make it clear that you know the likelihood of these events are extremely, extremely remote, but we want them to think of all the possible things that they might want to protect and why there would be a leak or how there could be a leak. [These stakeholders] were already well-versed and that's a rarity in terms of audience. I mean you have [potential project] areas where… there's no oil field activity or very little. And therefore people aren't aware of any of the technologies involved. And so everything's new and there's more potential there for a misunderstanding of what's going on."*

Although representatives from the other three projects did not specifically describe their risk assessment processes, all three reported that their communication materials evolved over time as additional concerns were raised by stakeholders. This process demonstrates that they were listening and responding to risks raised by stakeholders that were in addition to the potential risks the projects had included originally in their communication materials.

Topic 4. The overall plan for communicating the benefits and risks of CCS in the community

All of the interviewees reported that stakeholder engagement and establishing a plan for communicating about CCS was a priority for their company. Significantly, in their comments, interviewees tended not to distinguish between stakeholder engagement and risk communication per se but viewed them as integrally related – and indeed, part of the overall business risk. One interviewee emphasised:

> *"We definitely see that good stakeholder engagement early on is key to a project's success and that if – you know if bad news or misinformation gets out in front of you, it has the ability to delay or… to actually have a project cancelled. So, absolutely, it's essential that you get out and do good stakeholder engagement early on."*

This same person reported that their company recognises that the "non-technical risks are actually more challenging than the technical risks." They are willing to allocate adequate staff and resources to address them and have undertaken more than is required by the regulations. Emphasis is placed on addressing both the benefits and the risks. Recognising that there are actually very few local benefits, this company has made a "real effort to try to increase them – for example, spending as much as possible locally and regionally, including taking the extra step of identifying local suppliers that may be able to provide pipeline construction services and putting together a plan for two small local communities to try to maximise benefits for them."

This company recognises that since it does not have the direct experience of operating CCS projects, it needs to spend a lot of time on explaining CCS risks:

> *"Unlike most projects where we can say that we've done this before, we have a really good track record of operating facilities of this kind, or we've drilled thousands of wells – that sort of thing, we're not able to say with confidence that we've done this integrated large scale CCS project before – although we do say it with confidence we feel that this can be done safely. We've done all the various component aspects of this type of project before, but not at this scale.*
>
> *And so a lot of our conversations with our community tell us that the big concerns are about safety and about the uncertainties, and so we've spent a considerable amount of time trying to make sure that we have our key messages right."*

This company has drawn on its internal communications group to help inform the project team. This includes putting every member of the project team through a risk communications course and utilising a formally trained risk communicator in developing informational materials. The company went a step further and brought in an external communications firm to help them to put the information together in a comprehensive narrative rather than a bulleted list of facts and figures. The interviewee saw "the help we got for putting together the storage narrative was the most – the biggest value-add."

In retrospect, the interviewee also acknowledged that bringing in external expertise had the added benefit of bringing an outside perspective to the comprehensive narrative. Significantly, also, the project team's approach extended beyond its focus on a single project after the outside communications expert insisted on pointing out the link between the CCS project and the other energy projects implemented by the host company:

> *"And one of the pieces of advice that they gave us is that we seemed to be avoiding the [that] connection, and, to be honest, we as a project team were probably trying to shelter our project from that bad news, right?*
>
> *And these consultants basically advised us that if we don't make that connection, the NGOs will, [and] it would be better for us to take that ground first. And so we did, so our narrative actually bridges why we are doing this project and it is about our [other energy] assets."*

The interviewee for this project stressed that from the outset the company placed a priority on identifying and mitigating potential projects risks. This was done initially by in-house experts on storage and subsurface conditions. As the company planned to move to local communication efforts, the communication staff and the experts worked together to figure out how to talk with officials and lay people about the company's technical expertise and how to listen to the public. The results are that "they're very good at talking about the risks and how we're managing them. They also have held numerous in-person meetings to assess and address concerns. Significantly, these [discussions] resulted in changes to the planned project – specifically, 30 reroutes to pipelines and a series of other steps" that were documented and shared publicly.

Another project noted that a key element of their communication approach about technical risk was in framing the discussion with a focus on the benefits and safeguards of the project:

> *"We like to explain the benefits and we like to explain the safeguards that we have in place. We like to point out that other people that are also doing [CCS] without instances or issues as well as the numerous analogous industries that are doing it without instances or issues."*

When asked if the communications explicitly identify or address potential risks, the interviewee indicated that they:

> *"…kind of roughly describe the potential issues with the technology moving forward and what we're doing to address it, but we probably don't you know bring it too much to people's attention what the total adverse effects could be as we know as project developers that those risks are very low….[When worst case issues are raised] we have literature prepared, like [explaining] what happened at Lake Nyos in not applicable to CCS."*

In addition, this company tries to "provide a framework for evaluating risks." Essentially, they place a lot of emphasis on general education so that people have sufficient information about the project and the project team so that stakeholders can:

> *"…work through what they might perceive as risks and understand the extent to which those are minimised or, in fact, do not exist. We talk about the risks, but we also try to point out and educate them and get them to figure out that it's not a risk because they don't always understand what we're doing… So if you do that successively, you eliminate all the questions that are about more perceived risks like what happened at Lake Nyos."*

Meanwhile, however, the project team is prepared to discuss risks that may come up – for example:

> *"I just pulled together a response that what if we have a Japanese level magnitude earthquake in a commercial storage site and how does that affect that long term integrity of that storage site. [But] we probably wouldn't go out and say directly that earthquakes could impact storage sites as I am not sure they could.*
>
> *I guess what I'm trying to say is there's two levels. We're probably a little bit more open about pointing out the risk and then addressing it internally and to our internal stakeholders at the plants and with management. But in a news release or with a – a communication with the media, we probably would not do that, because that could run in the wrong direction and we're not there to respond to it personally on point and have the opportunity to elaborate on it."*

A second company concurred that they frame communication by focusing primarily on the broad benefits to the community, particularly the need for their company to be at the forefront in learning about CCS:

> *"We provide a broad overview, looking at all [the company is doing] in nuclear, gas, renewables, biomass … and emphasise why are we looking at CCS so – everyone's looking at it, but why are we spending so much time and effort and money looking at it is because it's our – it's our play in the future. I mean unless we want to just – you know totally repower to gas and kind of bear that burden moving forward, this is what we – this is what our logical play is."*

And a third company expressed a similar view indicating a focus on the benefits of the CCS project to the company and its employees. Notably, communication about the project does not focus on the larger societal benefit of mitigating climate change, but instead, on the benefit to the community of keeping the energy assets operating in the face of likely government legislation. In this way the company "avoids the larger debate about whether climate change is occurring and what the potential impacts could be" and, instead, frames CCS as an investment in the future:

> *"The only way to keep operating and keep that industry in the area is if we take a leadership role and help develop the technology for CO_2 control. ...so you focus on the immediate reality which is the most immediate reality to them which is: 'are these plants going to be around in 5,10,15,20 years? And what are we doing to ensure that the plant will still be operational?"*

This company does not avoid explicit discussion of risk; it has demonstrated a general policy of being "very receptive to questions – encouraging questions, including difficult questions, and answering whenever possible. If there is a question that cannot be answered immediately [we] always promise to get back in touch very soon and are very diligent about following up." The company used this kind of feedback to further improve their communication materials:

> *"As time has gone on, [we] have learned to expect some questions and now include them in any presentation. Sometimes that leads to more questions but [we] think that this shows [our] acknowledgment that there could be concerns about the technology."*

Two companies viewed risk communication as an extension of their "regular" every day communication activities. As one interviewee explained:

> *"One of the benefits that we have with some of our projects is that we're doing them at existing [facilities] where we've had ongoing community relations and risk communications in place already about operations [including other complex pollution and environmental control technology]. As things happen with our plant and even things that happened with [another company in the same industry], [they] will lead to the development of a communications program directed at our stakeholders around our plants. So we know the people who need to be engaged, and we've been engaging them over a period of time and there's a little evaluation in who those people are, but we obviously stay current on that as it can change."*

And, from another company:

> *"We always try to be on the forefront of when new information comes out. If we're going to do a modification to the plant, install new equipment or change the way we operate, we try to lead into that with a lot of public outreach so that you know people are comfortable with what is going to happen before it happens."*

Topic 5. The risks that most interest/concern stakeholders

With the exception of one company's experience, where the issue of property values was raised, there were very few surprises in this area. The interviewees largely indicated that they had done significant preparation in order to anticipate public concerns and have found that they were mostly prepared for what they encountered.

Common concerns and questions stemmed from clarifying existing experience, for example, explaining the difference between extraction and keeping CO_2 in the ground, and addressing potential concerns about competing land uses, such as the potential impact on farming. People also wanted to have the technical risks and safeguards explained.

The projects identified two specific misunderstandings:

1. The concept of how CO_2 is stored in the subsurface was not clear. Many stakeholders seemed to think that storage took place in large voids, like storage tanks, in the subsurface. The concepts of porosity and permeability were not well understood. Most the interviewees indicated that they routinely travel with rocks to physically demonstrate this process and have developed visual imagery to further clarify how the process works.

2. There was widespread concern about induced seismicity. The interviewees were asked if this concern was raised independently or seemed prompted by the provision of technical information. One person responded:

   "I don't think either. I think it just occurs to them. They just think "OK you're injecting something into the ground, so the ground is going to expand," they don't view the ground as being something that's infinite. The view is: if you stick something in the ground, its going to pressure up and the surface is going to kind of rise a little bit."

The concern about potential impact on property values was raised in only one of the reviewed cases. Interestingly, in one community in which a single stakeholder raised concerns about the safety of a project, the larger community reaction seemed to be focused more on the complainer than on the host company. Their concern seemed to be not that a safety problem in fact was occurring but rather that the landowner's complaints would create the perception of a problem that could affect their property values and would be difficult to refute going forward:

"And that was maybe why there was so much animosity directed towards the [landowner] at least from my perspective. From what I read in the blogs and online postings, people in that community were feeling that now [the project] was going to be infamous."

3.3 Lessons

The interviews revealed a number of lessons. Some of these were related specifically to communicating about the risks of the technology; others were related more broadly to an overall philosophy of effective interactions with the public.

Lesson One: *Recognise that the risks to the project are likely broader than the technical risks and commit, up front, to a comprehensive plan to address them*

This lesson was articulated especially clearly by an interviewee from one company:

"The license to operate – you know the license to construct, develop, operate is absolutely essential. And I think we as a company over the past number of years have had experiences with communities that tell us that our non-technical risk is actually more of a challenge than the technical risk. I think you'll see [that our CEO] talks about non-technical risk. And I think … that is a huge success.

So, absolutely committing to managing your non-technical risks right up front early on in a project is absolutely essential to any project's success. And I don't think that we have the magic bullet. I mean we [the host company] have seen things go south. And so, we're acutely aware of the downside of not managing stakeholder engagement. But you know it could still go south. It can go south so easily."

This company recognised the potential impact of technical and non-technical risk to the bottom line of the project, relating both to business risk by saying:

"Definitely recognising that non-technical risk can delay or stop a project, committing to adequate resourcing for it and having a plan – a mitigative plan that covers all aspects – the stakeholder engagement, the regulatory applications, making the right assumptions early on. I mean those are all best practice absolutely. But they don't guarantee you anything other than you hope that if something happens, you can jump on it quickly and respond and that you have a level of trust or respect that you'd be able to get it back under control quickly."

The question of resource commitment was not asked directly, but comes through in the interviews through quotes that have been included above that reference CEO focus on non-technical risk, local staffing levels, the depth and breadth of community relationships, commitment to meet frequently with the stakeholders and provide site tours, and the sense of going beyond mere best practices.

***Lesson Two**: Be open, respectful and responsive to the public*

A common thread that can be discerned throughout the interviews is the level of effort that the project teams dedicated to working with stakeholders to identify and address concerns as they were framed by those stakeholders, being open, and being respectful of and responsive to their perspectives. This lesson was emphasised in various ways by all of the interviewees.

For one company, being open involved preceding any change with discussion with the community. This included:

> *"…even the littlest change that might impact traffic patterns or something different from what we told the community early on."*

For another, company, it involved being respectful of people's viewpoints:

> *"I think it's important to acknowledge and show respect for the things that people think are risks, regardless of whether or not we think that they're risks. Because you really have no idea when something will or will not actually present itself as risk. And so I think we try to, even though we've heard the earthquake question a gazillion times, we try to respectfully answer it to the best of our ability and try to minimise that perception of risk by the listener.*
>
> *And corollary to that is that you're open and transparent. And you don't ever disrespect anybody's question no matter how many times you've heard it or you know what you yourself personally think about it. Because the question, it's both the question and the answer and the process, all of which are important and you really have to focus on all three.*
>
> *I think as scientists, we're told to never say never, right? [For example], talking about whether or not, and the likelihood and the severity of a meteorite hitting the well head. But you know, it is possible that could happen… and I think we, as the project team, are always very, very cognisant of the fact that risk, [both the technical risk and the public's more expansive views about risk], need to be addressed with equal levels of attention."*

For a third interviewee, being respectful of stakeholders' views included talking with stakeholders, taking their issues into consideration and making "real stakeholder change" to the project. An instance of this was the change of over 30 pipeline re-routes after face-to-face meetings:

> *"And if they didn't want our pipelines over their land, we found ways to reroute our pipelines to where they wanted."*

***Lesson Three**: Be proactive in the sense of planning ahead about issues that potentially could arise*

Again, all of the companies pointed to this lesson, albeit in different ways. One company emphasised the need to be prepared to answer any questions that come up. Another, noting that they had learned from a previous very negative experience, suggested always being on the lookout for potential opposition, stating:

> *"[We] are definitely on the lookout for any opposition. …just trying to be very proactive with our communications. Make sure that we're talking, not just to the community but to the community leaders. And asking them 'what's the word on the street? Are there things that you're hearing or are your citizens concerned beyond what we might be hearing in public meetings?' And that gives us a chance to prepare."*

Another company planned how to address difficult questions that could arise as a result of their linkage with another, more controversial industrial unit:

> *"So, I guess we looked at it – we actually recognised that some of the issues that [the other industrial unit] has had would probably come up. And so, we have a communications plan between us and [the other industrial unit] to make sure that [our] team knows the answers to the tough …questions [about the other unit]. And the – not that we would answer them all, but we would have a high level answer and then we would be able to point them in the right direction of the person at [the other industrial unit] to address them."*

Yet another pointed out that projects may face "targeted" opposition for a variety of reasons including some related to the larger context. When parties focused on the larger context work with local stakeholders, "one disgruntled neighbour can become an Achilles heel":

> *"I think it's the most important thing in communications is recognising depending on the size of your project, if it's [big], once you have a, any kind of disgruntled local resident. it [the project] will be targeted for different reasons such as concerns about [fossil energy].*
>
> *[At one project] …. "It was few very unhappy landowners who did not want any more industrial activity in the area and it didn't matter whether you could prove CCS was safe or not, they enrolled certain NGOs that were philosophically opposed to CCS to back them and that's, it didn't matter from that point, it was doomed in my view."*

This same person also emphasised that if problems arise, there may be legal constraints on who can get involved in communication and that it was therefore important to plan ahead for this contingency.

***Lesson Four**: Prepare for media interactions*

This lesson, which constitutes a particular aspect of the previous lesson of planning ahead, was articulated by two companies: one having had a negative experience; the other a positive experience. Both experiences, however, point to the role of the media in amplifying risk events and the need to be alert to this possibility when working on a project such as CCS which has been subject to targeting by some non-local organisations.

In the first case, complaints from an unhappy neighbour resulted in high media attention, including sensational headlines and stories that "went viral:"

> *"And that headline despite the fact that it was attached to a pretty good article that was more impartial in its analysis, that headline, whoever chose it, went viral and so we had people thinking there was CO_2 bursting to the surface and flinging animals into the air…*
>
> *…But anyway it's odd that the biggest communications challenge was not the report itself [making scientific claims of the leak] but the additional 16 page document at the [CCS opponent web site] that showed the bubbling water and the photographs taken by the Claimant."*

In the second case, where media exposure was positive, the company CEO had been very vocal about the project and their comments helped to generate positive interest. At that time the project was an early mover and as a result, there was world-wide media interest, where "media from all over the world came to write about it."

Some of the "take-home" lessons that the interviewees took from these two experiences were:

- Prepare – keep media contacts fresh; recognise that sound bites have a way of sticking in memory; identify and work with reporters that can get the kind of coverage you need on the local, national, and international level;
- Be prepared to commit large resources (e.g. staff, budget) to work with the media:

  > *"We – I don't think we spared any expense at hosting media. Any enquiry we ever got, where somebody wanted to tour, write about it, see it, you know those kinds of things, we would bend over backwards to make sure we gave them a first class tour…And you know, that's a big commitment… There were months where [we] were just driving, doing a 4 ½ hour round trip down to the plant, two or three 3 days a week. And then spending a few hours with the media."*

- Have independent experts at the ready to weigh in and be viewed independently, especially if a risk could be amplified and given wide publicity that can negatively affect CCS projects elsewhere;
- Help to develop a more educated blogosphere; and
- Educate the tier of NGOs that have taken the time to become informed on the facts of CCS, develop a relationship with them, and contact them if breaking events are likely to result in media coverage.

***Lesson Five**: Use appropriate visual aids and analogies to help communicate concepts to the public and keep them simple*

One company reported that, in addition to a model of the sequestration process, they always make a point of having rock samples available, and this "goes a long way towards visually demonstrating to people where the CO_2 is being stored, which seems to decrease the perceived risk of stored CO_2 when you recognise that it's not a big hole in the ground for example or a cavern." In addition:

> *"We've continually tried to convey the magnitude or the concept of depth. So where is the ground water with respect to the depth of the storage of CO_2. This is similar to the way that CCP did with its brochure. Fold out, stratigraphic column, our materials follow that path as well. We have a vertical poster with a very deep two scale visual of where the stored CO_2 is relative to the 80 or 100 feet depth wells where people get their water. We have tried to use science to demonstrate or show in our communication process that some of the risks that people think are out there are not necessarily really risky.*
>
> *And we also use analogy a lot. Our project leader is very good at using analogy… we talk about the geologic basin as a seven layer casserole, where you have layers of material that are stratified in a bowl, in a casserole dish, and we spend a lot of time adapting what we say to the specific audience that we are saying it to. Analogy helps a lot in that process."*

Another project emphasised the importance of "keeping it simple," stating:

> *"Simple – simpler is better, we have a standard, very simple cross section that I use that shows some cap rocks and some storage rocks when I'm explaining the basics. I don't like to show the slides that show OK, well CO_2 can be stored in coal seams and oil fields and depleted gas fields that have all kind of different geological storage repositories in one slide. I like to show the basic saline reservoir, flat geology, fixed sand stone formations. Kind of real conceptual."*

Another interviewee cited visuals that they had found to be useful:

> *"Standard cross-sections and slides that help explain how CCS is implemented and managed. One of the slides that was especially effective "had the subsurface and CO_2 going into pore space and being trapped and it says CCS storage will look like this, and then next to it we had CCS storage will not look like this and it had a big cavity like a cave in the subsurface with just CO_2 in that cavity. Its gets the point across that storage happens in the pore spaces of rocks where the CO_2 is trapped and not in a cavity where it can be released back to the surface."*

Part 4. Risk Communication Resources

This report aims to provide the reader with a better understanding of the ways in which stakeholders may view CCS project risk in order to help them develop more effective and productive risk communication programs. There is significant overlap among the work necessary for general outreach and communication planning, social site characterisation, and risk communication. The materials and resources in this report build on two previous reports prepared for the Commonwealth Scientific Industrial Research Organisation (CSIRO) through support from The Institute: the Communication and Engagement Toolkit for CCS Projects[37] and Social Site Characterisation: from Concept to Application.[38] The emphasis in this report is on helping the reader to expand their perspective on how they assess, mitigate, and communicate project risk. Traditional approaches start with the characteristics of a technology or project as the basis for considering project risk. This report attempts to show the reader the importance of adding an effort that starts with the characteristics of the community as a basis for considering project risk.

As indicated in the introduction, effective risk communication is thought to be part of a stakeholder engagement process that can also facilitate a broad risk mitigation/project benefit effort, however, it is not a panacea. In reviewing the literature, the interviews, and many risk communication manuals out in the public domain, it is clear that solid relationships can help to

[37] CSIRO, Communication and Engagement Toolkit for CCS Projects, op. cit.

[38] CSIRO, Energy Transformed Flagship, Social Site Characterisation: From Concept to Application, (2011) online at: http://cdn.globalccsinstitute.com/sites/default/files/publication_20110629_social_site_characterisation_0.pdf

improve the quality of discussion over projects, and especially where there are conflicting views; however, that alone may not be sufficient to overcome the conflict. The challenge comes in building a strong relationship with the community based on trust, two-way communication, and the ability to find common ground.

This section discusses four topics. The first relates to framing the effort, the second suggests an approach for developing a comprehensive assessment of project risk, the third highlights some key pointers drawn from other industries, while the final topic highlights a list of external risk communication resources that may be helpful in assisting CCS project teams to plan project related risk communication programs. Throughout this section, company names and websites are provided. The authors do not necessarily endorse the use of these resources but present them for illustrative purposes. Further, all communities are different and it is important to note that the project team will need to determine which techniques and tools make sense for the specific community in which they are operating.

4.1 Framing

This report does not address risk communication in the context of a crisis or event, but on communication during non-crisis times. It focuses on general risk communication that accompanies routine project implementation and is conceived as being part of a broader stakeholder engagement process as highlighted in the interviews outlined in Part 3. Risk communication related to an event or crisis often seeks specific action from targeted groups in order to ensure their safety and to ask them to take specific actions.[39] This report, in contrast, assumes that one of the main purposes for risk communication, in this context, is to inform and engage stakeholders but not necessarily to ask them to take action.

Classic "how to manuals" in risk communication walk through a series of planning efforts to define the goal, message(s), messenger(s), audience(s), context(s), and implementation of a program. This terminology, which tends to reinforce a concept of risk communication as a one-way rather than the two-way process of relationship building, is therefore not used in this report. Further, as highlighted in the interviews, understanding how the various community members view project risk is a prerequisite for developing the elements in an effective risk communication program.

4.2 Suggested approach for expanding and addressing the understanding of project risk

The authors suggest an iterative five-step strategy for learning how the community views the project and developing effective risk communication programs.

4.2.1 Conduct preliminary site assessment

Assessment of project risks begins during the site selection process. During this process, the project team will collect readily available information to assess the technical and non-technical characteristics of candidate sites. Site selection is considered to be one of the fundamental steps in minimising project risk. In order to have integrity, and, ultimately to be permitted, the planned site must have sufficient and secure storage capacity that is physically bounded by a confining layer, or impermeable rock formation, and not intersected by faults or fractures. The project must also demonstrate that injection operations will not compromise this fundamental integrity. However, not all sites are alike and some sites that are perfectly suitable for storage projects may have certain features that need to be addressed through project design – for example, the confining layer in one area may be able to withstand greater injection pressures than the confining layer in another area. It is likely that much of the initial technical information necessary to make a preliminary determination of site suitability can be collected from publicly available data sources or through minimal activity in the community.

During this stage, the project team can also initiate a social site characterisation to develop a preliminary understanding of the community's economic and social structure, community organisations, activities and perspectives. This information is available in secondary sources (e.g. census data, local organisations' literature, local newspapers, and other public sources), but could be expanded to include low-key, informal interviews with key members of the community.[40]

[39] It would behove project developers to consider the types of events that might lead to the need for crisis communication and the steps they would undertake in this situation. See the U.S. Department of Energy Best Practice Manual for Public Outreach for carbon Storage Projects for some guidance on this. http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_PublicOutreach.pdf

[40] CSIRO – Social Site Characterisation, op. cit.

For a project team that is comparing the attractiveness of a number of sites, the relative anonymity of this preliminary assessment may have competitive value. However, at some point in the site selection process, the project team will need to begin interacting with the local community. At the point when the project has to "go public" it may prove useful if the project team has not only already outlined an approach for considering the range of technical criteria that are important for storage security but also conducted a preliminary risk assessment to determine the site's strengths and potential weaknesses. Such transparency can help as a first step in building a relationship with the community around a storage project. There are a number of tools that the project operator could use to develop this:

- For siting criteria in sequestration well and CO_2 injection well regulations for example:
  - The U.S. EPA Underground Injection Control Program Class VI and Class II Well Regulations;[41] and/or
  - The European Union CCS Directive[42]
- The International Energy Administration (IEA) Risk Scenarios Database[43] provides a tool for using the Features, Events, and Processes (FEPs) related to the long-term behaviour of injected CO_2 to systematically assess project risk.
- The U.S. Department of Energy has developed a best practices manual for site selection that outlines a screening sites.[44]
- The CO_2 Capture Project Technical Basis for Carbon Dioxide Storage[45] includes a chapter on site selection and the group has published a paper on CO_2 Site Certification processes.[46]

4.2.2 Identify community perceptions of project risks

As a project team selects a site, it will begin much more detailed site characterisation and risk assessment. This information will inform project design and also the risk communication program. During this detailed site characterisation, the project team should strive to identify the community perceptions of the project and the related project risks. The bottom line in developing a risk communication program is to start with risks as perceived by the various publics that make up the community. Such an approach may be of both direct and indirect value. Directly, it acknowledges and responds proactively to public concerns that if not openly addressed at an early stage could mushroom into major points of contention. Indirectly, it demonstrates consideration for legitimate community concerns – a respectful approach that may reap benefits in terms of building relationships and ultimately enhance the potential for mutual respect and constructive engagement in future interactions.

The project team can engage the public in a number of different ways. On one end of the spectrum are informal assessments, for example using one-on-one interviews or focus groups to obtain feedback about the project.

A more intensive effort might include conducting informational workshops in which preliminary project and risk information is shared with stakeholders and structured discussion is used to assess:

1. The extent to which the identified risks reflect community concerns;
2. The language community members use to interpret those risks and describe their reactions to them;
3. The extent to which planned risk mitigation satisfies concerns; and,
4. Additional concerns or perceived risks that were not identified internally.

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[41] Chapter 40 U.S. Code of Federal Regulations (CFR) Parts 144-146 for regulations pertaining to the Underground Injection Control Program – accessed online July 8, 2011 at: http://water.epa.gov/type/groundwater/uic/regulations.cfm

[42] European Commission – Climate Action: A Legal Framework for the Safe Geological Storage of Carbon Dioxide – Accessed online July 8, 2011 at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0114:0135:EN:PDF

[43] IEA Risk Scenarios Database, accessed online July 8, 2011 at: http://www.ieaghg.org/index.php?/20091223132/risk-scenarios-database.html

[44] U.S. DOE, Best Practices for Site Screening, Site Selection, and Initial Characterization for Storage of CO_2 in Deep Geologic Formations, DOE/NETL-401/090808, November 2010, accessed online July 8, 2011 at: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM-SiteScreening.pdf

[45] CO_2 Capture Project, Technical Basis For Carbon Dioxide Storage, January 2009 – see section on site selection, accessed online July 8,2011 at: http://www.co2captureproject.org/index.html

[46] Oldenburg, CM, Bryant, SL and Nicot, J-P. Certification Framework Based on Effective Trapping for Geologic Carbon Sequestration, Int. J. of Greenhouse Gas Control 3, 444–457, 2009, LBNL-1549E.

A more intensive effort could also involve conducting joint risk assessment exercises with stakeholders who represent key viewpoints in the community. There are a number of approaches for eliciting risk assessments from experts and stakeholders. Schlumberger Carbon Services has pioneered the use of this approach for conducting risk assessments for CCS projects and has written about it in several papers.[47,48,49] This approach is also described in a presentation to one of the WESTCARB (one of the U.S. Department of Energy Regional Carbon Sequestration Partnership) annual meetings.[50] In this approach, technical experts review the IEA FEPs to develop a starting list of risks that are pertinent to the project. Participants in the assessment develop their individual rankings of the likelihood and severity of the potential negative impact of those FEPs on several different project values that might include "health and safety, environment, financial, advancing the viability and public acceptability of a GS [CCS] industry, and research."[51] Then participants are broken into small groups to develop consensus rankings of the FEPs. Throughout the process, new FEPs or risks can be added. This effort is primarily conducted for risk management purposes. But it contributes other benefits. Namely, the process can help to build a cohesive view of risk within the project team and the results inform risk communication.

4.2.3 Risk communication materials and discussion topics

Once project team members understand how the community views the project and perceives project risks, they can develop appropriate risk communication materials and discussion topics as part of their overall stakeholder engagement effort. This will include ways to convey risk issues and associated mitigation activities in written materials, interviews with and responses to media reporters, and also in community discussions. Typically, other topics will be included in addition to CCS risks and mitigation strategies – for example, why the project is needed, why this community may be suitable, what the potential benefits are and how the project is further engaging with the community so that its members will have an opportunity for input.

The lessons from the projects indicate that risk materials and discussions should:

- Address the concerns as raised by stakeholders, recognising that there are likely to be variations among stakeholders;
- Use straightforward language that is not overly technical;
- Be honest about what is known or not known; and,
- Provide visual and/or multi media explanations where possible.

Additionally, as highlighted by the interviews, discussion of project risks should be part of an open and transparent approach that prepares the public for any project changes that might occur as the project evolves and seeks to incorporate their input into ways in which the project design could be adapted to their benefit. Meanwhile, as outlined in Section 4, it behoves the project team to be prepared for media interactions recognising that headlines can amplify risk events and have national and global, as well as local impact.

4.2.4 Testing materials and monitoring project perceptions

Testing whether the project team is communicating effectively is straight forward, yet this is frequently not done. Testing can be done informally by asking a small number of stakeholders to provide feedback, or more structured feedback can be obtained through the use of focus groups. The value in this step is to assess the effectiveness and impact of information used to explain the project and address concerns. Over time, as the project progresses, risk assessments should be updated and the results should be used to update and improve risk communication materials.

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[47] Hnottavange-Telleen, K., Krapac, I. and Vivalda, C. Illinois Basin-Decatur Project: Initial risk-assessment results and framework for evaluating site performance, Energy Procedia 1 (1) (2009), pp. 2431–2438.

[48] Hnottavange-Telleen, K., Chabora, E., Finley, R., Greenberg, S., Marsteller, S., "Risk management in a large-scale CO_2 geosequestration pilot project, Illinois, USA," Energy Procedia, Volume 4, 2011, pp. 4044-4051, 10th International Conference on Greenhouse Gas Control Technologies.

[49] Hnottavange-Telleen, K., From Decatur to Denver: Progress with information capture for CCS risk assessment. Presented at IEA GHG Risk Assessment 5th Network Meeting, May 2010. Available at http://www.ieaghg.org.

[50] Hnottavange-Telleen, K., "A 'FEPs" Approach to CCS Risk Assessment and Management," WETSCARB Annual Business Meeting, September 15-17, 2009, accessed online July 8, 2011 at: http://www.westcarb.org/pdfs_scottsdale/KenHnottavange-Telleen.pdf

[51] Hnottavange-Telleen, K., (2011)

In addition, the project team should look for ways to monitor how the community perceives the project as it is implemented over time. One of the projects interviewed indicated that they do this by routinely, but informally, checking in with community leaders by asking how they (the project) is doing. The interviewee indicated that they felt this effort both showed their real interest in hearing from the community and also recognised that community members might be more likely to talk to leaders within the community than with representatives from the project. Project members can also review local newspapers and community blogs. And, they might want to consider more formal mechanisms such as routine polling or focus groups.

4.3 Key points

This section reiterates key points that were reflected earlier in this report and come directly from other risk communication materials.

4.3.1 Dedicate appropriate resources

Several interviewees discussed the importance of adequately resourcing risk communication efforts. In this context, budget and staffing combine into an overall level of effort and demonstrated commitment to the community. Typically this is indicated by awareness and involvement of top management.

The Australian Centre for Social Responsibility in Mining commissioned a risk communication guide. It underscored the importance of committing not only financial but also institutional resources to risk communication. The following text box is taken from the guide and presents organisational barriers to risk communication programs.

Organisational Barriers to Risk Communication

From the perspective of those charged with the responsibility of delivering an organisation's risk communication messages there can be many organisational restraints that prevent them from carrying out their role effectively. Common barriers include:

- *Inadequate resources.* Organisations prioritise analysis over risk communication and frequently allocate minimal resources to the communications function.
- *Difficult review and approval procedures.* Organisations also constrain risk communications by establishing review and approval procedures that are either inappropriate or time consuming. In crisis situations, or where particularly hostile stakeholders are involved, risk communicators need to be able to respond quickly and proactively.
- *Conflicting organisational requirements.* Organisational policies regarding the release of confidential information, and which information channels should be used, may conflict with the goals of good risk communication. These problems can generally be avoided with pre-planning.
- *Insufficient information to plan and set schedules.* Detailed information is needed to prepare communications plans and to set schedules for the release of information. Important information includes legal/compliance obligations, organisational requirements, how the risk communications plan fits in with scientific developments and the technical risk assessment process and coordinating actions with government and other stakeholders. The credibility of the risk communications plan depends on reliable data, effective planning and clear messages
- *Negative attitudes towards stakeholders.* Unwillingness to see the public as an equal partner and a conviction that the lay public cannot understand science and should therefore leave risk management 'to the experts' will inevitably lead to risk communications messages that only succeed in creating community outrage and mistrust.

Source: Risk Communication: A Framework for Technology Development and Implementation In the Mining and Minerals Processing Industry, Centre for Social Responsibility in Mining, University of Queensland, Australia, October 2009, http://www.csrm.uq.edu.au/docs/Risk%20Communication%20NOV%202009.pdf.

4.3.2 Prepare

Several participants indicated the need to diligently prepare for risk communication by doing the work necessary to understand community views on risk. The Australian Centre for Social Responsibility in risk communication guide also underscored the importance of preparation. The following text box is taken from the guide and presents the barriers to risk communication programs stemming from lack of preparation.

Constraints for Communicator and Audience

There are barriers to effective risk communication that pose challenges for communicators and audiences alike. These are:

- *Incomplete data.* The inherent uncertainly, complexity and incompleteness of much scientific data means that it is extremely difficult for risk managers to determine the potential harm posed by new technologies to health, social welfare or the environment. Many gaps remain in relation to our understanding of these risks, making it difficult, if not impossible to separate cause from effect. As a result, the result of most the outcomes of most risk assessments are best seen as estimates, with varying degrees of uncertainty about the actual nature of the risk. This is a difficult message for risk communicators to deliver to stakeholders.
- *Selective reporting by the news media.* Journalists are highly selective about reporting risk and particularly inclined towards stories that involve people in unusual, dramatic, confrontational, negative or sensational situations. In short, they tend to focus their attention on issues that play to the same outrage factors that the public uses in evaluating risk.
- *The changing knowledge base for communicators and stakeholders.* New scientific developments, the readily accessible sources of new information about projects that is provided by the media and public disagreement between experts mean that risk communications professionals need to be flexible, adaptable and in a position to respond proactively to new information. The ready availability of information means that the public's knowledge base is constantly expanding and risk communicators need to be prepared to meet these challenges.

Source: Risk Communication: A Framework for Technology Development and Implementation In the Mining and Minerals Processing Industry, Centre for Social Responsibility in Mining, University of Queensland, Australia, October 2009, http://www.csrm.uq.edu.au/docs/Risk%20Communication%20NOV%202009.pdf

4.3.3 View risk communication as part of your overall stakeholder engagement process

The Keystone Center prepared a risk communication primer for CCS. It stressed the importance of integrating risk communication with overall stakeholder engagement. The following textbox highlights the role of building trust through the engagement process.

Trust

The common thread through problem identification, risk communication, and stakeholding is the element of trust:

- A first step is to identify of the kind of communication that is needed. This is accomplished through evaluation of the complexity of the problem. "Wicked" policy issues that are characterized by lack of agreement on the problem and lack of agreement on the solution are less amenable to a conventional, expert problem solving approach and will require input from various perspectives.
- "Understand the different lenses through which stakeholders view problems and possible solutions. There's a saying: Where you stand depends on where you sit…Indeed, the evaluation of risk is always personal. Ipso facto, the communication of risks to the public requires an understanding of the personal ways risks are seen to affect people individually and as part of stakeholder groups."
- "Risk communication includes the open sharing of information and acknowledgement of concerns. It incorporates and appreciates diverse opinions and perspectives in an atmosphere of consensus building."
- "Achieving the highest and most desirous level of [public] acceptance requires building trust, maintaining credibility, and ensuring confidence in government. In turn, this usually requires moving beyond the conventional public participation procedures that are required by law. Said differently, public hearings and expert advisory bodies are necessary but insufficient."
- "Public Involvement" is a public process that seeks to involve constituents in framing both the problems they anticipate as well as the solutions to those problems. Where PR tends to be primarily one-way communication, public involvement is interactive and consultative. It is a dialogue.

Source: A Primer on Perceptions of Risk, Risk Communication and Building Trust, The Keystone Center, 2005, http://www.netl.doe.gov/technologies/carbon_seq/refshelf/reg-issues/TKC%20Risk%20Paper.fin.pdf

4.3.4 Lessons from the nuclear industry

Some of principles spelled out by Fischhoff may be directly applicable in planning risk communication related to CCS. Although initially written nine years ago for the nuclear industry, the principles are very consistent with the themes we heard in our interviews and are excerpted below:

Principles

In fact, the industry's relationship with the public must be paramount. That means worrying at the highest levels of management about whether the industry actually has a story worth telling, in the sense of bringing genuine benefits and acceptable risks to society. The principles listed below are, in effect, corollaries of adopting the strategy of achieving this aim:

Senior management must be committed to treating communication as a strategic activity, not an afterthought. Organizations that forgo direct two-way communication with the public (especially when they disagree) are choosing to fly blind, relying on intuition, rather than evidence, regarding the conditions necessary for public acceptance.

Management must consider communication in all activities. A firm's public face can be shaped by any of its actions… those actions include how it maintains plants, disposes of waste, conducts siting processes, lobbies for permits, participates in electoral politics, deals with neighbours in routine times and emergencies, and treats workers.

Management must assume stewardship over the life cycle of its technology. A firm's reputation depends not only on its own actions, but also on the actions of the organizations that provide it with ancillary services, such as independent audits, regulatory oversight, materials transport, waste handling, and personnel screening.

Management must press for industry-wide discipline.

Management must separate public affairs communications from public health communications…Public affairs communicators worry about defending the firm; public health communicators worry about defending those affected by its actions.

Management must staff its public health communications adequately. Effective public health communications require four distinct kinds of expertise: subject-matter specialists; risk and decision analysts; behavioural scientists; and system specialists.

Management must learn from experience. Evaluating the quality of a firm's communications requires assessing how well it has understood the public that it affects and how well the public has understood it. Those assessments require applied social science, conducted with the methodological rigor of peer-reviewed research.

Management must value its intangible assets. Effective communications require adequate resources… Management needs to remember that the intangible asset of trust bears tangible returns in the form of reduced uncertainty about public acceptance and regulatory approval, as well as reduced executive time putting out avoidable fires.

Source: Fischhoff, B., The nuclear energy industry's communication problem, Bulletin of the Atomic Scientists, February 2009

4.4 Existing manuals on risk communication in other fields

There are several risk communication manuals that are available online and can provide the reader with additional background information and ideas for their own risk communication programs. These resources are included for additional information. As highlighted in this report, the terminology and understanding of risk communication theory and practice has evolved over time and readers are advised to use their own discretion in utilising them.

1. Adler, P., J. Kranowitz, A Primer on Perceptions of Risk, Risk Communication and Building Trust, The Keystone Center, 2005, http://www.netl.doe.gov/technologies/carbon_seq/refshelf/reg-issues/TKC%20Risk%20Paper.fin.pdf
2. Food and Agriculture Organization of the United Nations (FAO), World Health Organization (WHO), "The application of risk communication to food standards and safety matters," Food and Nutrition Paper #70, 1998, ISBN 92-5-104260-8, http://www.fao.org/docrep/005/x1271e/x1271e00.htm
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7. U.S. Environmental Protection Agency (EPA), National Risk Communication Conference 2001 – Proceedings Document http://water.epa.gov/scitech/swguidance/fishshellfish/techguidance/upload/2008_09_19_fish_forum_2001_riskconf.pdf
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9. U.S. Nuclear Regulatory Commission, Effective Risk Communication (NUREG/BR-0308): The Nuclear Regulatory Commission's Guideline for External Risk Communication, 2004 http://www.nrc.gov/reading-rm/doc-collections/nuregs/brochures/br0308/

Part 5. Conclusion

Although there are quantifiable aspects to risk, there are also other less quantifiable aspects that can be of great importance to the person evaluating risk for themselves. As even Slovic himself came to acknowledge *all risk assessment is subjective*.[52] Over time, social science literature on risk perception and risk communication has identified the importance of using an understanding of how people view risk as a central point in developing effective risk communication programs. This paper briefly summarised some of the key literature in this area. Further, the paper explored the extent to which this concept is being applied in current CCS projects by reviewing project approaches to risk communication. In general, the five reviewed projects have successfully engaged the local community. That is not to say that there has not been any controversy over these projects. However, all of the projects demonstrated a sincere effort to both anticipate and identify stakeholder concerns and then to address those concerns through risk management and risk communication efforts. In all cases the projects are moving through siting and implementation. The authors draw several lessons from this review:

1. Stakeholders will likely view risk in a more expansive way than project developers, one that combines technical and non-technical elements. Stakeholder perceptions will be based on several factors including their values, affiliations, personal experiences, views of the community, and their views of the project and its context.
2. The non-technical risks may provide a greater challenge for risk mitigation and risk communication than technical risks.
3. Project developers should attempt (and will likely gain significant value from attempting) to ascertain how community members view project risk, how they understand the project dimensions and context (i.e. what is their language or mental model of sorts), and what is necessary to address or mitigate the full range of those concerns. Project developers should consider addressing the full range of risks as part of the upfront management priorities (e.g. project design, planning, budget).
4. Risk communication is intertwined with risk management and mitigation. Project developers are well-advised to integrate risk communication in overall risk management by, for example, training the project team to be sensitive to differing views on risk, training staff on communication techniques, and devoting sufficient time and resources to develop and implement communication programs.

These lessons do not provide hard and fast "rules" for developing risk communication programs. Indeed, perhaps the essential rule is the need for understanding one's community and basing one's risk communication approach on that understanding. A major challenge is that different communities and/or different people in the same community, may react to the same information or approach it in entirely different ways. As a result, Part 4 suggests an approach for identifying community members' perceptions of risk and provides links to a series of risk communication manuals. It is important to note that the guidance in these manuals varies. *This variation underscores the point that developers should seek expertise in social science and communication in their project team.*

Further, the authors suggest several areas for additional research including the following:

1. How do early risk communication efforts impact stakeholder perceptions of a project as it progresses?
2. How does the perception of risk change as a project is implemented and completed?
3. Based on the above assessments, what are the implications for evaluating the effectiveness of a risk communication program and making necessary adjustments or adjusting to changing conditions?
4. What are the most effective ways for risk communication if an event or accident occurs at a CCS project? How does the risk communication program need to change once such an event is over and mitigated?
5. Are there examples of projects where initially very negative perceptions about its risk have become more positive? How did this change occur?
6. What are the most useful visual aids for communicating CCS?
7. How do local views on government oversight or regulation influence perceived risk?
8. The projects included in this study had strong ties to their communities. Is this a necessary factor? Are there other ways to build such relationships?
9. What lessons can be drawn from various approaches to risk communication workshops? Are there lessons to be learned by comparing formats, features, and so on?
10. Are there lessons to be drawn from reviewing the risk communication guidance from other areas such as terrorism, emergency response, food safety, environmental safety, and other such areas?

[52] Slovic, op. cit., 1979.

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APPENDIX A

Interview protocol – general questions

1. What is the community like in which the project is taking place?
2. Can you give us a brief sense of how well-established the host company is in the community in which the project will take place?
3. Do you believe that the host company has become the trusted source for technical and non-technical information about CCS and the project?
4. In your communications, have you explicitly focused on communicating the benefits of CCS and/or the local community benefits from the project?
5. In your communications, have you explicitly focused on communicating the risks of CCS? Would you characterise this as more of a case of responding to concerns as you identify them or more proactively explaining risks?
6. What are the risks that most interest/concern stakeholders and were you surprised by this?
7. Did you come up with any special visual aids or materials for communicating the risks and benefits of CCS projects to your stakeholders?
8. Project specific question.
9. Project specific question.
10. Are there any stand out lessons that you have learned about communicating the risks of CCS that you have not yet shared with us?

COMMUNICATING THE RISKS OF CCS