Public Perception of Carbon Capture and Storage Technology

June 2-3, 2008
Cambridge, Massachusetts

WORKSHOP REPORT

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Report on a workshop organized by the Energy Technology Innovation Policy research group of the Belfer Center for Science and International Affairs at Harvard University's John F. Kennedy School of Government.

The workshop was held at the Harvard Kennedy School on June 2-3, 2008.

Introduction and Motivation

On June 2 and 3, 2008, the Energy Technology Innovation Policy (ETIP) research group at the Harvard Kennedy School's Belfer Center for Science and International Affairs convened a group of 38 members of academia, industry, government, and non-profit organizations experienced and interested in public perception, communication, and social acceptance of carbon capture and storage (CCS) technology.

The goal of the workshop was to provide a forum in which recent experiences, activities, and research related to public perception challenges and opportunities of demonstrating and deploying CCS technology could be shared. The workshop brought together a diverse set of stakeholders to collectively examine CCS public perception issues through a contextual critique and analysis of four specific CCS projects.

Background

CCS is a technology intended to mitigate the accumulation of carbon dioxide (CO_2) in the atmosphere by capturing CO_2 from fixed point sources (such as coal-fired power plants) and injecting that captured CO_2 into geologic formations where it will be contained for hundreds to thousands of years (and perhaps more). Deployment of CCS relies on a myriad of interactions among technologies, markets, institutions, regulators, and society. Confidence about the technical feasibility of CCS has been growing, yet like any technology its deployment will be influenced by many social factors. Favorable public perception and social acceptance of CCS technology may prove to be crucial for widespread deployment of CCS.

As the number of CCS-related projects is growing, and the potential for CCS technology to contribute to reducing CO_2 emissions is becoming more prominent in societal debates, issues related to the public perception and social acceptance of this technology are becoming more salient. Public perception and social acceptance are framed by, among other influences, individual and collective decision-making behavior, perceptions of risk, ability to interpret and assimilate information, and the media portrayal of related information.

Workshop Structure

The one and a half day workshop had a roundtable format. On the first day, after the participants briefly introduced themselves, two short presentations by social science scholars provided participants with some theoretical context for considering the issues associated with CCS public perception and social acceptance. These academic presentations focused on risk communication and decision-making, as well as communication, rhetoric, and the media. The remainder of the first day was then devoted to discussions of four examples of public engagement on CCS. Each example was introduced briefly by representatives involved in the specific example; an open discussion including all participants followed.

The first example described a public information meeting on CCS in Wiscasset, Maine, where the Twin River Energy Facility, a coal and wood biomass gasification plant, was proposed. The second example focused on the BP Carson Hydrogen Power Project in Carson, California. The third example described the extensive and geographically diverse CCS outreach experiences

of the U.S. Regional Carbon Sequestration Partnerships, and the fourth example focused on outreach associated with the FutureGen project in Illinois.

The second half-day of the workshop began with a summary and review of the previous day's discussion. An open-discussion, in which the participants had the opportunity to synthesize and integrate aspects learned from the different projects and experiences, followed.

This workshop report provides some background, a summary of the brief presentations, and the discussions.

Presentation 1: Developing Effective Risk Communication

The first presentation provided a theoretical context and perspective on developing effective risk communication. This presentation introduced the need for effective risk communication, identified critical features of risk communication, presented examples of effective and ineffective communications, and reviewed the "mental model" approach to risk communication from a psychological perspective. Effective risk communication has normative, descriptive, prescriptive, and evaluative components; these four components are associated with four critical questions to ask when communicating risk: (1) Normative: What should people know? (2) Descriptive: What do people already know? (3) Prescriptive: What do people still need to know? (4) Evaluative: Was the communication effective?

Procedurally, addressing these questions should involve an interdisciplinary approach, and the process should be iterative. It is essential that an *interdisciplinary* team be formed to address what people should know. While many efforts to communicate risk are based on scientific research, the assertion was made that initiatives often lack an interdisciplinary panel, fail to define misconceptions and gaps in knowledge, fail to understand *how* people need to learn what they should know, and often use language that people do not understand. If the goal is for lay people to understand information and incorporate it into their activities, it is important for the interdisciplinary communication team to work with and understand the public with whom they are communicating.

Discussion of this presentation highlighted that perceptions of the "messenger"—the individual or institution presenting the information—are very important. For example, people have different reactions to, and levels of trust in, representatives of the government, academia, industry, and non-profit organizations. While the mental model approach helps to craft the message, it does not explicitly incorporate provisions for the importance of the messenger. Similarly, it is well known that the media influences what and how people understand issues. While the media is, in some respect, the recipient of the message (of communicated risk), it is also an interpreter and messenger as well.

Presentation 2: Communication, Rhetoric, and the Media

The second presentation had a broader social focus; it provided a theoretical background on communication, rhetoric, and the media. The level of concern in risk debates can be related to the relative degree of complexity and the intensity of conflict. For a low level of concern, there is generally low intensity of conflict and low complexity. In this case, the communicator's role is to provide the most accurate information and transfer knowledge. For a moderate level of

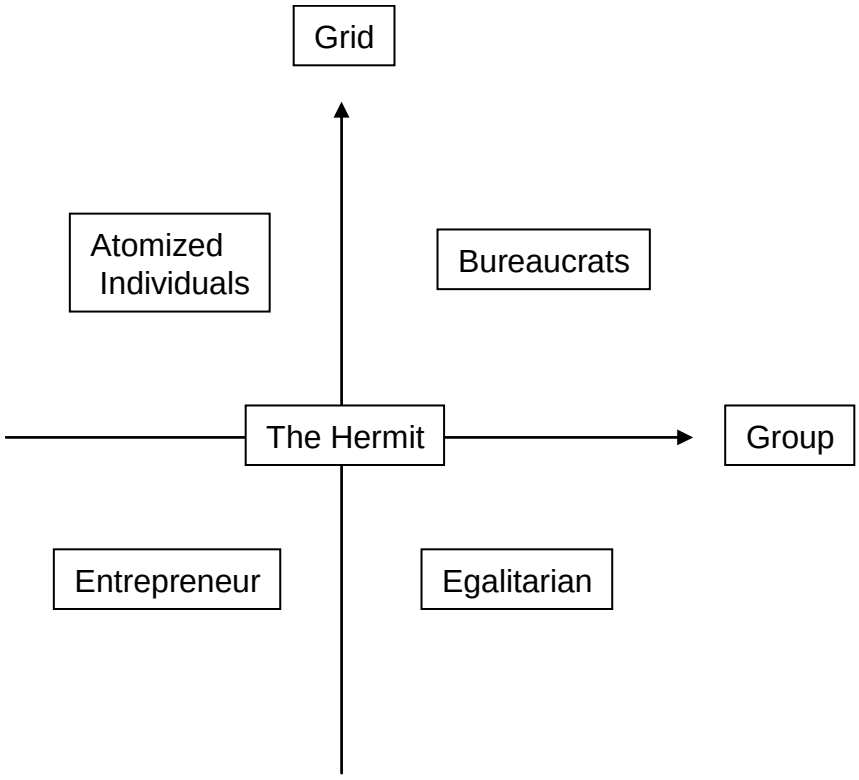
concern, there are moderate levels of complexity and intensity of conflict. At this level, experience, competence, and trust are very important, and technical information does not matter as much as the audience's perception of the messenger and the nature of their previous experiences with that messenger. At this level, dialogue with stakeholders and the public is valuable. A situation with a high level of concern is the most challenging; it occurs when worldviews and value systems vary and both the degree of complexity and the intensity of conflict are high. For communication at this level, it is important to use dialogue and mediation, to channel dissent and argument in a constructive way. Communicating technical information about a specific technology is not the most important or effective kind of information to convey when there are different worldviews and values involved in relation to an issue or area where there is a high level of conflict. The levels of concern and conflict also have important temporal dimensions, i.e., low-levels of concern over long periods of time can escalate conflict even without major changes in complexity.

It was acknowledged that while reframing risks is sometimes easy, it can be counterproductive in the long run because individuals may not have the opportunity to debate and engage with the issue in the context of their personal worldviews and values.

A cultural anthropological perspective was presented to demonstrate how different types of individuals need different communication strategies. A two-by-two matrix, or grid, distinguished five types of individuals based on the degree to which "the group" and "the grid" are important to them: Atomized Individuals, Bureaucrats, Entrepreneurs, Egalitarians, and Hermits (see Figure 1). Egalitarians and Bureaucrats consider the group highly; in contrast, Entrepreneurs and Atomized Individuals do not place much importance on the group. For Atomized Individuals and Bureaucrats, the distinction between types of people, i.e., their location in the grid, is important, whereas Entrepreneurs and Egalitarians do not place much importance on these roles. Egalitarians, for example, value the community and generally believe risks should be avoided unless they are inevitable to protect the public good. Risk communication toward this group needs to incorporate the larger community; presenting a cost-benefit analysis, for example, to Egalitarians is unlikely to be effective. In contrast, Atomized Individuals perceive that life is a lottery and risks are out of our control. Risk communication strategies must be developed with the perspective of what will work best for each type of individual. Hermits are in the middle of both spectrums and believe that risks are acceptable as long as no coercion is involved. Different types of individuals will provide different challenges for effective communication.

The nature of the understanding of the risk matters as well. Risks with high levels of uncertainty need *reflective discourse* in which people engage with the uncertainty and decide as a group what the proper level of protection should be. Where high ambiguity exists, good facilitation of a *participatory discourse* is important. People need to be content with the process that produced the outcome, even if they do not like the result of the deliberation.

Figure 1. Risk taking in the context of cultural categories. Adapted from T.R. Peterson's presentation. June 2, 2008.



Example #1: Chewonki CCS Seminar in Wiscasset, Maine

The first example focused on a day-long CCS seminar in Wiscasset, Maine, a community where a new power plant was being proposed. The Twin River Energy Facility is a proposed gasification facility to be fueled with coal and wood biomass. The site of the proposed facility is attractive for a power plant because of the existing transmission and rail infrastructure; the site was previously part of the former Maine Yankee nuclear power plant, and prior to that had been the location of a coal-fired power plant. The potential for CCS technology to reduce CO_2 emissions from the Twin River facility emerged during the public discourse about the proposed plans. In response, in October, 2007, the Chewonki Foundation, a local non-profit environmental education organization, organized a day-long educational seminar on CCS. The Chewonki event was organized to inform decision-makers and the public about CCS technology – the intent of this seminar was not to describe the proposed project and how CCS might or might not be a part of it. Over 100 influential state and local decision-makers participated in the seminar, in which a panel of CCS experts, mostly from outside of Maine, presented on various aspects of CCS technology and its role in a portfolio of climate mitigation technologies. An evening event, with a subset of the invited panelists, was open to the public and provided an opportunity for the local community to engage with presenters about the general topic of CCS.

Participants in the day session filled out surveys before and after the seminar. These surveys were designed to assess how the participants perceived CCS technology when they arrived and how these perceptions changed as a result of the seminar. In the quantitative section of the survey, respondents were asked to rank, on a scale of 1 to 5,[1] their level of understanding and support of CCS technology, the degree to which they had concerns about CCS technology, and whether or not they thought CCS should be considered *only* as a part of a portfolio of CO_2 mitigation measures. Participants reported that their understanding of, and support for, CCS technology increased during the seminar. In addition, agreement that CCS should be a part of a portfolio of mitigation measures increased. Concerns about CCS were positively correlated with understanding of the technology, but the level of concern did not significantly change as a result of the seminar. It appears as though the respondents had general concerns about CCS technology prior to the seminar and, as they learned more throughout the day, they were able to identify what those concerns were. Participants reported that they supported CCS more at the end of the day, but their concerns drove them to support it only as a part of a portfolio of approaches.

Potential CO_2 storage locations are an important aspect of CCS technology, and the lack of obvious storage locations in Maine or even the entire Northeast may have been influential in the perceptions of CCS on the part of the respondents. Neither the project developer nor any of the speakers could identify specific CO_2 storage locations in the Northeast; several panelists explained that there are, at present, no known onshore formations in the Northeast that are amenable to geologic storage of CO_2. Some offshore options might exist, but the current state of knowledge does not include any known storage prospects. Respondents' strong level of support for CCS technology in general therefore, must be interpreted with the caveat that participants might have understood that storage of CO_2 was not likely in, or proximal to, Maine. As such, respondents could have been more supportive of the technology in part because the long-term storage of CO_2 is unlikely to affect them.

Workshop participants discussed how, from one perspective, the Chewonki seminar could be considered a success; the respondents reported that they learned new information about CCS and this information influenced their perceptions of CCS. But significant concerns with the seminar were also identified, mostly with respect to the design and implementation of the event. It was evident that while the seminar was informative and helpful, it did not address the local and project-specific concerns of the participants. By design, the invited speakers and panelists were there to discuss various general aspects of CCS technology, and were not prepared to address the specific issues raised about the proposed Twin River facility and Maine's energy infrastructure. Some of these issues include the fact that Maine is already a net exporter of electricity, has no existing coal-fired facilities, and how increased barge traffic might interfere with lobstering.

In addition to the apparent mismatch between the audience's concerns and presenters' expertise, the role and perception of the messenger was also discussed. Some public skepticism of the Twin River Energy project developer, unrelated to claims related to potential for CCS, seemed present. And then, as the community learned that the option to add CCS may not be

[1] 1 = Disagree completely; 2 = Somewhat disagree; 3 = Neutral; 4 = Somewhat agree; 5 = Agree completely. The survey also included some open-ended questions in which participants could describe the benefits and drawbacks of CCS.

viable in Maine due to a lack of storage opportunities, trust in the developer could have decreased even further.

The presenters at the Chewonki CCS seminar knew a lot about CCS and could address some general risks associated with the technology, but for many participants, issues not associated with CCS risk seemed to be more salient. Workshop participants suggested that including additional members of the target audience in planning the seminar could have mitigated this disconnect.

Example #2: BP's Carson Hydrogen Power Project, Carson California

BP's Carson Hydrogen Power Project, announced in 2006, was to be a 500 MW hydrogen-based electrical plant in Carson, California, using petroleum coke as a feedstock. Ninety percent of the CO_2 produced by the plant was to be captured and injected in the Long Beach Unit of the Wilmington Reservoir for sequestration and enhanced oil recovery (EOR). The project team began looking for an alternative siting location in the Fall of 2007 because of issues associated with the complicated ownership of the oil field into which the CO_2 was to be injected and the resulting inability of BP to get sufficient stakeholder commitment to purchase the CO_2 for EOR. Although the project had not yet submitted a permit application for regulatory and public approval, there was an indication that there would be some local opposition, primarily from some vocal neighbors and members of the local environmental justice community, despite strong support from other neighborhood organizations and local community leaders.

BP was proactive with respect to outreach and communication in the Carson project; company representatives designed and implemented a series of public outreach activities about CCS and the proposed hydrogen power project. BP conducted outreach for two years, briefing more than 300 people including federal, state and local officials, community leaders and environmental organizations. In addition, they developed a broad CCS public education strategy that was not about the specific project. BP's outreach approach incorporated the communities that they were seeking to inform. For example, they had a Hispanic outreach team as well as a local community outreach team. They also cooperated with authors of a story book for children that included information about CCS technology.

BP stated that they had to correct some assertions by a few individuals that CO_2 is toxic, and found it important to convey that oil and gas firms have a lot of knowledge about how CO_2 behaves, and how CO_2 storage is understood and modeled. But apparently, some members of the local community were familiar with, and skeptical of, the perceived message of "it's safe, trust us."

The proposed Carson project, like the Twin River Energy Facility, was sited in large part because of the presence of existing infrastructure. Carson is a highly industrial area with scores of chemical plants, oil refineries, and associated other large scale industrial facilities. From one perspective, given the industrialized nature of the area, the impact of a CCS project seemed minimal; it simply involved the addition of a few more pipelines to the area (in this case, CO_2 pipelines). From another perspective, the location was a concern. The Carson project added another large facility to an area that already had many industrial facilities and other environmental concerns. The question of spatial inequality of risks is thus raised when siting CCS projects in

already industrialized regions: i.e., How much is too much? When should additional industrial projects be halted in a community? Relating to the earlier presentation about risk communication, levels of concern, conflict and complexity, it was noted that in existing industrial areas, community concern may emerge not from the details or the complexity of the proposed project, but from historical contextual complexities.

Even though a project might be technically viable in a particular location, public perception may be significantly influenced by the degree to which the area is already saturated with industrial activity. Additionally, the evolution of the community's relationship with industry is important. People who have experienced environmental injustice in the past may be more likely to oppose new projects in the future regardless of the particular project or its merits. Many factors contribute to community preferences and risk tolerances.

Example #3: United States Department of Energy Regional Carbon Sequestration Partnerships

In 2003, the US Department of Energy (DOE) initiated the Regional Carbon Sequestration Partnerships (RCSP), creating seven regional entities to help determine the most suitable technologies, regulatory, and infrastructure needs for carbon capture, storage, and sequestration in different areas of the country. There are three planned phases for the partnerships: (1) Characterization, (2) Validation, and (3) Deployment. The Characterization Phase, which, among other things, resulted in broad scale geologic characterization of potential storage reservoirs, was completed in 2005. Over 350 organizations are involved in the partnerships, including 41 states, four Canadian provinces, and three Indian nations.

Public outreach, education, and engagement are critical components of the RCSP program. RCSP outreach efforts have created a network of individuals involved in RCSP communication and provided a forum for sharing experiences and providing feedback. These activities have yielded some specific lessons that can guide future CCS outreach. Three of these lessons include: (1) develop a solid understanding of stakeholders' concerns and perceptions, (2) develop, use, and make accessible materials to address various concerns, and (3) through openness and transparency, gain broader public "permission" to conduct a project.

Several specific public outreach challenges have emerged from the coordinated experiences of conducting CCS outreach within RCSP. These challenges vary by location due to geographic and social diversity, but some identified challenges include general skepticism toward new technology, lack of familiarity of the natural carbon cycle, lack of scientific knowledge in the audience, distrust in government, and the perceived resource competition with renewable energy or energy efficiency.

RCSP outreach activities can be divided into two categories: (1) general public education efforts aimed to increase broad public awareness and understanding of CCS and the RCSP project, and (2) education and communication for stakeholders and communities associated with specific projects. Within each of these categories, RCSP outreach includes: conducting research, developing communication materials, devising specific activities appropriate for difference audiences, and considering how to measure the results of different communication approaches. The RCSP have used focus groups, media analysis and one-on-one conversations. Responses and communication strategies have also been adjusted and refined as a result of the accumulation

of different experiences. One question to consider is, "what are the most appropriate tools that can be used to evaluate the practical experience being gained in the RCSP outreach efforts?"

The experience gained by the RCSP outreach efforts shows that the public asks reasonable questions, and these questions are instrumental in understanding specific public concerns. Technical issues are only one part of the communication process; people are also concerned about a fair decision process, relationships (trust), and accountability. All of these may be incorporated in what appear to be technical questions, such as "who will be there if things go wrong?", (i.e., who is accountable?) "How capable is the government of implementing carbon sequestration in a manner that protects public health and the environment?" Some might lack faith in the certainty of the "science," while others might not trust the accountability – perhaps because of a specific experience or perception of the breakdown in the integrity of those believed or promised to be accountable. Concerns about such a breakdown could be direct, from state officials, or indirect, from failure of government oversight, for example.

All of the concerns the public have are valid, but none of them are universal. Public concerns vary by the circumstances of the people involved because "there are many publics." In addition, evaluating outreach efforts of the RCSPs is difficult both because conventional evaluation tools (e.g., surveys) do not seem appropriate given the small size of the initial projects and there are constraints on the use of federal funds for certain evaluative tools (e.g., surveys).

Example #4: The FutureGen Alliance

FutureGen is a public-private partnership conceptualized by the US Department of Energy (DOE) to demonstrate the combination of technologies needed to have fully integrated energy production, carbon capture, and geologic sequestration. The project is designed as a 275 MW coal-fired Integrated Gasification Combined Cycle (IGCC) facility that produces electricity and hydrogen fuel as well as captures and stores CO_2. The FutureGen project involved a competitive site-selection process in which seven states submitted proposals for 12 total sites. After a thorough review, four sites were ultimately selected as semi-finalists. Environmental Impact Statements, as required by the National Environmental Protection Act, were prepared for all four sites; two of these sites were in Texas and two were in Illinois. The Mattoon, Illinois location was ultimately chosen by the FutureGen Alliance, an organization comprised of 13 of the world's largest energy companies.

The competitive siting process was a unique feature of the FutureGen project. Ultimately, two states, Texas and Illinois, vied for the opportunity to have the facility sited in their state. Public outreach and public acceptance issues related to CCS with the FutureGen project that were unique to the Illinois FutureGen experience were discussed. The example presented was from Illinois, and public outreach methods or outcomes for Texas were not discussed. Anecdotal examples were given for one aspect of the outreach efforts, those conducted by the Illinois State Geological Survey (ISGS), surrounding the Illinois FutureGen effort. According to the ISGS, the public response to FutureGen was successful on many levels; positive public response, active engagement, interest in bringing project to Illinois, and increasing awareness of CCS throughout Illinois. It was stated that the FutureGen project was largely viewed by the public as a positive opportunity, and the Illinois communities seem to have a general desire to have the facility sited in their towns. Public reluctance or skepticism may have

been minimized by the competitive nature of the goal to attract FutureGen to Illinois and the potential for economic benefit for the state.

From the beginning of the FutureGen siting effort, the State of Illinois engaged a team of local, regional, and state experts to engage the public in discussion. The team included the Department of Commerce and Economic Opportunity (DCEO), the Department of Natural resources, the Environmental Protection Agency (Illinois and USEPA Region 5), the cities of Mattoon and Tuscola, the economic development offices from Coles and Douglas Counties, state and federal legislators, and industrial partners and consultants. The State of Illinois focused on creating a joint effort to bring FutureGen to Illinois; the project would benefit both communities, which are about 25 miles apart, the Illinois coal industry, and the entire state. Individual business development organizations for each community worked very hard to bring the project to their community and supported each other in their efforts.

It was noted that Illinois and Texas had previously competed as finalists for another major Federal project, the Superconducting Super Collider (SSC). In 1998 the SSC was awarded to Texas. Even though Congress cancelled the SSC five years later, the loss of the SSC to Texas was an example of a project with which state agencies (specifically the ISGS) were familiar.

A potential major driver of the social acceptance of FutureGen in Illinois was the economic opportunity to benefit from the native geology. Illinois has significant coal resources and is focused on clean coal technologies to use these resources. In addition, the Mt. Simon sandstone reservoir makes the Illinois Basin a likely place for deep saline geologic sequestration. FutureGen was supported for its economic benefits as well as the possibility of revitalizing the state coal industry, which was impacted by a decrease in demand for high sulfur coal. The visibility of FutureGen as a world class research facility that would bring international attention and potentially attract visitors from all over the world was another appealing feature of the project. A feature that made the selected site at Mattoon and the site at Tuscola attractive was the proximity to three state universities and three community colleges that could be involved in the facility. The 1,000+ jobs that FutureGen would create also contributed to its favorable perception. In general, the FutureGen project was portrayed positively in the local media.

Since the political dynamics of particular projects can be quite different, the ISGS outreach representative highlighted how important the team work aspect of the FutureGen outreach effort was and the importance of working with the local economic development agencies in addition to regulatory agencies. Project proponents need to understand what issues are unique and specific to each set of constituents. The importance of working within the local state structure was also noted. The outreach team accepted multiple speaking invitations in order to maximize opportunities to engage and connect with community members. The analysis by the Department of Energy, with their Environmental Impact Statements, helped to assure the public that due diligence was being done, and the informational sessions in advance of the public forums gave the public the opportunity to engage in a conversation about CCS. The development of hands-on models also gave individuals the opportunity to visualize and experience first-hand what geologic storage entails.

Given that one of the major benefits of FutureGen in Illinois was the economic opportunity to use native coal, workshop participants discussed the question: What if such an economic benefit does not exist for other projects? Can a CCS site be acceptable with the public

if there are no large economic benefits? Even without the strong perceived economic benefits associated with the FutureGen project, the approach taken by the State of Illinois is likely to be useful because the outreach was conducted simultaneously on multiple levels engaging local land owners, the local institutional infrastructure, and at the more general state level. The discussants examined this concentric approach as a possibility for future outreach efforts and agreed it might be an interesting research approach to test in the future. It was acknowledged that without the economic and public recognition of benefits perceived to be associated with the FutureGen Project, the social acceptance might have been more difficult.

The issue of the message versus the messenger was brought up when discussing this example because the ISGS is unique in its role as an unbiased expert that has scientific knowledge, a state presence, and a good relationship with the public. The discussion acknowledged how commercial entities may be viewed by the general public with more skepticism than academic entities. While research and demonstration projects may provide useful technical information for commercial projects, research projects do not necessarily provide a complete blueprint for the development of outreach strategies for commercial projects. Research projects do, however, contribute to the understanding of engaging and informing the public about CCS. A question that was raised is "how does the perception of, and reaction to, the messenger change as the community has more familiarity with the technology?"

Overarching Themes, Lessons Learned, and Future Directions

After exploring the four specific examples on the first day, the second day of the workshop was a semi-structured discussion designed to allow participants to interactively reflect on and synthesize the lessons learned and common themes from the four cases, as well as to define and discuss potentially useful future areas of research in this area.

One challenging issue that was identified is the growing "anti-coal" sentiment in the United States. Two recent phrases were mentioned that demonstrate flip sides of the concern: (1) "No coal without CCS" and (2) "No CCS because it promotes coal." Workshop participants considered how CCS outreach and communication strategies might effectively incorporate CCS concerns associated with the continued use of coal. Depending on the local community, the close association between coal and CCS technology can result in both positive and negative perceptions of CCS technology. Participants discussed the importance of presenting and framing CCS technology in outreach efforts within an appropriate context, as one technology among a portfolio of climate mitigation strategies.

A recurring theme in the discussions was that there are the many different "publics" for which communication strategies can be designed. Building public acceptance involves recognizing that there is no one-size-fits-all prescriptive approach that can be applied broadly to all situations involving CCS outreach. Individuals and communities vary in their backgrounds, the type and extent of information they have, the type of information they need, or believe they need, their values, and their concerns. The questions that the public raises are critical and valuable for those developing communication strategies and materials. These questions can and should guide communicators in their own understanding of what issues the public cares about. But, again, it can be difficult to fully understand what underlies the questions and whether or not the outreach addresses these drivers.

An important distinction was made between issues, concerns, and communication associated with public acceptance of CCS technology in general terms and those associated with a specific community's acceptance of CCS technology—especially when that community is confronted with a proposed CCS project in their locale.

Questions were raised about how academic researchers can interact most effectively with those who are actively engaged in public outreach on CCS and how academic researchers should interact with the public. The concern was raised that social science research involving interaction with the public can actually have an effect on public perceptions of CCS and the unfolding of projects. This is a particular challenge in the early days of deploying CCS projects because there is a concerted effort to build trust-based relationships – they are a work-in-progress. Another challenge lies in developing appropriate methods for evaluating public perceptions and the effectiveness of communication activities. Focus group interviews and other localized assessments have yielded valuable information and insight, but this knowledge may not be applicable at broad levels. It is, at present, unclear what other tools might be used to evaluate public perceptions at this stage of CCS development. It was agreed that future discussions to identify ethical and non-invasive procedures for evaluating CCS communication efforts are needed.

The four examples presented during the workshop were all located in the United States, and this fact was identified and acknowledged as a limitation of the discussion. At the same time, there are many unique aspects to a U.S. constituency that warrant such focused attention. Due to limits in time and space, much academic work and practical experience related to CCS public perception was not incorporated into the discussion. Enhancing comparative international activity in this area is clearly an area with much potential.

Many of the participants agreed to reconvene during the 9th International Conference on Greenhouse Gas Control Technologies in Washington DC in November 2008 and discuss and explore potential future collaborations.

Appendix 1

PUBLIC PERCEPTION OF CARBON CAPTURE AND STORAGE TECHNOLOGY WORKSHOP
Energy Technology Innovation Policy (ETIP) research group, Harvard Kennedy School
June 2-3, 2008

Workshop Goal: This workshop will convene a focused group of academics and practitioners interested in, and experienced with, the public perception of carbon capture and storage (CCS) technology. The goal of the 1.5 day workshop is to integrate and assimilate recent developments in understanding public perception of CCS technology related to demonstration and deployment for climate change mitigation. By providing a forum to discuss and critique public perception and communication strategies in several specific projects involving CCS technology, the workshop will enable participants to engage in discussion and analysis of public perception and communication issues and to synthesize commonalities and differences among current/recent experiences and research.

Workshop Agenda

Monday June 2, 2008 (Location: Taubman Nye Conference Rooms A&B)

8:30	Arrival and Continental Breakfast
9:00 - 9:45	Welcome and Individual Introductions, **Kelly Sims Gallagher, ETIP, Harvard Kennedy School**
9:45 – 10:15	**Wandi Bruine De Bruin, Carnegie Mellon University**, Risk communication and decision-making. (Theoretical context, Part I)
10:15 – 10:45	**Tarla Rai Peterson, Texas A&M,** Communication, rhetoric, and the media. (Theoretical context, Part II)
10:45-11:00	Break
11:00-12:00	Case #1. Twin River Energy Center, Wiscasset, Maine. **Jennie Stephens, Clark University** and **ETIP, Harvard Kennedy School** and **Jeff Bielicki, ETIP, Harvard Kennedy School.** Brief introduction followed by discussion and analysis. Moderated by John Holdren.
12:00 - 1:15	Lunch
1:15-2:15	Case #2. BP Carson, California, **Iain Wright** and **Tiffany Rau, BP.** Brief introduction followed by discussion and analysis. Moderated by Henry Lee.
2:15 - 3:15	Case #3. Carbon Sequestration Regional Partnerships **Sarah Wade, AJW Group** and **Judith Bradbury, PNNL.** Brief introduction followed by discussion and analysis. Moderated by John Holdren.
3:15-3:45	Break

3:45 – 4:45 Case #4 FutureGen outreach and communication at the state-level **Sallie Greenberg, Illinois State Geologic Survey.** Brief introduction followed by discussion and analysis. Moderated by Henry Lee.

6:00 Reception followed by dinner. (Harvard Faculty Club, 20 Quincy St., Cambridge)

Tuesday June 3, 2008 (Location: Taubman Allison Dining Room)

8:30-9:00 Continental Breakfast

9:00-9:45 **John Holdren, Harvard Kennedy School**. Synthesis of insights from previous day, and proposal of discussion questions.

9:45- 10:00 Break

10:00-12:00 Synthesize and integrate commonalities and differences among the cases and review the spectrum of public perception challenges highlighted in the cases. Discuss possible best practices for future projects and also clarify the future research agenda (in break-out sessions and then as a group). **Moderated by Kelly Sims Gallagher, HKS**

12:00 Adjourn

Appendix 2

PUBLIC PERCEPTION OF CARBON CAPTURE AND STORAGE TECHNOLOGY WORKSHOP
Energy Technology Innovation Policy ETIP, Harvard Kennedy School
June 2-3, 2008

NAME	AFFILIATION
Mohammed Al-Juaied	Saudi Aramco
Peta Ashworth	CSIRO
Jeff Bielicki	Energy Technology Innovation Policy, Harvard
Erica Bollerud	Climate Change Division, US Environmental Protection Agency
Judith Bradbury	Pacific Northwest National Laboratory
Wandi Bruine de Bruin	Carnegie Mellon University
Ananth Chikkatur	Energy Technology Innovation Policy, Harvard
Heleen de Coninck	Energy research Centre of the Netherlands (ECN)
Paige Evans	University of Minnesota
Miriam Fischlein	University of Minnesota
Lauren Fleishman	Carnegie Mellon University
Kelly Gallagher	Energy Technology Innovation Policy, Harvard
Sallie Greenberg	Illinois State Geologic Survey
Heleen Groenenberg	Energy research Centre of the Netherlands (ECN)
David Haines	Shell Exploration and Production
Bill Hogan	Harvard Energy Programs
John Holdren	Energy Technology Innovation Policy, Harvard
Wendy Jacobs	Harvard Law School
Barbara Kornylo	Shell Oil Company
Henry Lee	Energy Technology Innovation Policy, Harvard
Louisa Lund	Harvard Energy Programs
Sean McCoy	Carnegie Mellon University
George Peridas	NRDC
Tarla Rai Peterson	Texas A&M University
T. Ramakrishnan	Schlumberger
Gabe Rand	Clark University
Tiffany Rau	BP
William Rosenberg	E3 Ventures
Dan Schrag	Harvard University Center for the Environment
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Carbon capture and storage (CCS) is a technology enabling to use fossil fuels in a sustainable way. Therefore, it attracts much attention from the industrial sector, government authorities and scientific community. However, public awareness of the technology is extremely low, and the studies of the lay people's opinion have been launched only during the last decade.Â As part of our review, we determined 9 key aspects forming the public perception of CCS. For each of the key aspects, we summarized the available results of the studies. Apart from that, we compared the CCS current status in different countries and provided a number of reasons for involving new countries into the fight against global warming. Technology that can keep carbon dioxide emissions from entering the atmosphere and stoking global heating will be essential to tackle the growing climate crisis, experts say. But how does it work , and why will it make a difference in fighting climate breakdown? What is carbon capture, usage and storage (CCUS)? This refers to a chain of different technologies that can keep the carbon dioxide produced by major factories and power plants from reaching the atmosphere and contributing to global heating. The first step is to fit factory chimneys with solvent filters, which trap carbon emissions bef Carbon capture and storage (CCS) is regarded as an important bridging technology to a sustainable energy production. Whether it will be deployed on a large scale depends on both technological advances and social processes. Public perception of CCS can be crucial, and research interest in this topic has been growing. This review analyzes the public perception research thus far (42 articles were identified). Laypeople's concerns and spontaneous reactions to the technology have been thoroughly analyzed, and the results form a good basis for risk communication about CCS. What deserves more researc Friends of the Earth, Germany carbon capture and storage circulating fluidised bed Community Liaison Officer Commonwealth Scientific and Industrial Research Organisation (Australia) European Energy Programme for Recovery environmental impact assessment environmental non-governmental organisations enhanced oil recovery European Union frequently asked questions front end engineering design Global Carbon Capture and Storage Institute Hydrogen Energy California integrated gasification combined cycle Jamestown Board of Public.Â Social studies often discuss acceptance of new technologies as being governed by individual perceptions of benefits and risk, with the former needing to outweigh the latter to achieve good acceptance (Wallquist and. Carbon capture and storage (CCS) is a technology enabling to use fossil fuels in a sustainable way. Therefore, it attracts much attention from the industrial sector, government authorities and scientific community. However, public awareness of the technology is extremely low, and the studies of the lay people's opinion have been launched only during the last decade.Â This work shows that most attention is devoted to CO2 storage; whereas its capture and transportation are poorly studied in terms of public perception. Wider development is required for the methodology enabling a transition from global rhetoric concerning global warming issues to the implementation of particular projects, namely, CCS.