

Environmental non-government organizations' perceptions of geologic sequestration

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Received 23 November 2007

Accepted for publication 29 May 2008

Published 6 June 2008

Online at stacks.iop.org/ERL/3/024007

Abstract

Environmental non-governmental organizations (NGOs) have been influential in shaping public perceptions of environmental problems, their causes and potential solutions. Over the last decade, carbon capture and storage (CCS) has emerged as a potentially important technological response to climate change. In this paper we investigate how leading US NGOs perceive geologic sequestration, a potentially controversial part of CCS. We examine how and why their perceptions and strategies might differ, and if and how they plan to shape public perceptions of geologic sequestration. We approach these questions through semi-structured interviews with representatives from a range of NGOs, supplemented by content analysis of their documents. We find that while all the NGOs are committed to combating climate change, their views on CCS as a mitigation strategy vary considerably. We find that these views are correlated with NGOs' histories of activism and advocacy, as well as with their sources of funding. Overall, most of these NGOs accept the necessity of geologic sequestration, while only a small fraction do not.

Keywords: Environmental NGOs, carbon capture and storage, geologic sequestration, perceptions

1. Introduction

Non-governmental organizations (NGOs) have historically been influential in shaping public perceptions of environmental problems, their causes and their potential solutions. They are therefore an important part of the political process of creating and enforcing environmental laws (Cohen 1995, Jepson 2005). This paper investigates the current and future roles of NGOs in the US in shaping public perceptions of geologic sequestration of carbon dioxide (CO₂), a technology that is being widely discussed as a storage method for mitigating climate change.

Geologic sequestration is one of a set of storage technologies (e.g., terrestrial sequestration, ocean storage, and chemical mineralization) that are part of an overall climate change mitigation solution called carbon capture and storage (CCS)¹. CCS involves capturing CO₂ from fossil

fuel combustion exhaust or from the air, and then storing it safely away from the atmosphere, for example in porous rock deep underground. While the capture of the CO₂ is expensive, it is a common and uncontroversial industrial process. CCS for mitigation purposes, on the other hand, is a new and incompletely understood technology that will require government approval, and that may be visible to the public, especially at the sites where the CO₂ is injected (IPCC 2005). Moreover, CCS is part of a larger debate about the future of fossil fuels versus other sources of energy such as nuclear power or renewables. This paper begins to explore the political strategies that US environmental NGOs may pursue with respect to this technology.

Over the last decade, many in the expert and advocacy communities have begun to think that CCS (and therefore geologic sequestration) may be a viable and important technological response to climate change (Parson and Keith

¹ In this paper CCS will refer to carbon capture with geologic sequestration.

1998, IPCC 2005). In recent years, US political leaders have begun to talk about geologic sequestration as well. Little research has been done, however, to understand what NGOs' views are of these technologies, or if and how they plan to share them with the public. In this paper we ask, how do leading environmental NGOs active in the US perceive geologic sequestration? What might explain variations among NGO positions on this topic? And, how do they plan to share their views with the public, and otherwise engage in the politics of geologic sequestration and climate change?

The political impetus for geologic sequestration as part of US energy policy is growing (Princen and Finger 1994). An example of this at the federal level is the investment in a series of 25 pilot-projects by the Office of Fossil Energy at the US Department of Energy (DOE) (Princen and Finger 1994, Carbon Sequestration Home Page 2008). At the state level, in 2006 Texas lawmakers passed House Bill 149 which provides liability protection to fossil-fuel-based power providers who sequester CO₂ by transferring the ownership of the CO₂ to the state (McDonald 2007). Additionally, in California assembly member Huffman authored Assembly Bill 705 that mandates the California Environmental Protection Agency to develop regulations and standards for geologic sequestration as a climate change mitigation strategy². Increasingly, political leaders and advocates speak as if geologic sequestration were a well-understood, reliable technology, ready to be used in large scale in conjunction with continued fossil fuel use.

Over the past few decades, however, conflicts over unpopular energy policies such as nuclear power have demonstrated the importance of societal acceptance for the successful implementation of new technologies (Johnson 1987, Rowe and Frewer 2000). Evidence suggests that the lay public tends to trust information presented on energy technologies by NGOs, and environmental public-interest groups in particular (Jepson 2005), more than similar information presented by corporations or even government agencies.

The confluence of these environmental, political, and social factors suggests that NGOs' view of geologic sequestration may play an important role in shaping future energy policy. NGOs represent, and in a sense 'speak for', the public, especially the part of the public that constitutes their support and donor base. In this paper we investigate how environmental NGOs perceive geologic sequestration, how and why their perceptions and strategies might differ, and how they plan to share their views with the public. Our analysis will be accomplished through the results of one-on-one interviews with representatives from selected NGOs, as well as a review of NGO histories of activism and sources of funding.

2. Methods

Climate change experts were interviewed from nineteen NGOs specializing in the environment and environmental justice³.

² Although AB 705 did not pass in 2007, it is likely to be reintroduced in 2008.

³ We are treating chapters of Environmental Defense and Natural Resources Defense Council as distinct organizations, because the regional chapters often have different campaign foci and region-specific views on global environmental issues.

	Positive	Neutral	Negative
Necessary	7 (E, TT)	5 (E, TT)	4 (E, EJ, TT)
Unnecessary	0	0	3 (E, EJ)

E - Environmental
EJ - Environmental Justice
TT - Think Tank

Figure 1. Positive, neutral, and negative versus necessary and unnecessary.

We focused on traditional public-interest environmental groups and think-tanks, and not on industry-supported 'NGOs' and think-tanks, although these are, of course, also interested in influencing the public. The NGOs were purposively selected such that their spheres of influence ranged from international policy circles to the local grassroots levels. Expert interviewees were identified through a search of NGO websites and snowball⁴ recruiting methods. Our study covered most of the NGOs with a strong US presence that are actively working on climate change mitigation, and more specifically on mitigation technologies including, but not restricted to, CCS. In general, we sought views that were representative of the organization, but individual opinions were also stated in the course of our discussions.

Our primary method of information gathering was the semi-structured interview. We developed an open-ended interview guide in which the eventual outcome of the interview process is understood to be shaped by the interaction between interviewer and interviewee (Mishler 1986). The strength of this method is that it is more likely than a conventional survey to allow interviewees to respond in their own terms, using their own language, and also to provide unexpected arguments and descriptions (Bewley 2002).

The open-ended interview covered four topics: (a) the work done by the interviewee and organization; (b) the organization's view of geologic sequestration as a way to mitigate climate change; (c) education of the public on this technology; and (d) the public's potential reaction to this technology. The interviews ranged from 15 to 45 min in length depending on the time constraints of the interviewee.

Based upon a content analysis of the interviews and climate change related documents, if any, we developed a typology of NGO views of geologic sequestration. The first of the two axes is the NGO's opinion of geologic sequestration (positive, neutral or negative) and the second is of its perceived necessity (necessary or unnecessary) as part of a mitigation solution (see figure 1).

For the first axis, we split the NGOs into three groups with respect to geologic sequestration: positive, neutral, or negative⁵. Positively inclined NGO interviewees described

⁴ Snowball or nominated sampling is a non-probabilistic sampling method in which participants already in the study recommend other persons to be invited to participate (Richards and Morse 2007).

⁵ We note that on occasion, an interviewee categorized as positive identified negative aspects of the technology but overall remained extremely positive. The reverse phenomenon also occurred. We looked through each interview several times in its entirety to ensure that we represent, as accurately as possible, the overall views of the organization with respect to geologic sequestration.

Table 1. Summary of organizational positions on geologic sequestration. (Note: it is possible that the positions of the organizations whose representatives we interviewed will change as geologic sequestration policy unfolds in the US. It is also the case that NGOs are not monoliths, and that multiple viewpoints exist within them. Table 1 represents our assessment of each NGO's overall position in 2007.)

	Organization	Type
Enthusiasts	Climate Registry (CR)	Environment
	Environmental Defense-TX (ED)	Environment
	Natural Resources Defense Council-CA (NRDC)	Environment
	Natural Resources Defense Council-DC	Environment
	World Resources Institute (WRI)	Think Tank
	National Council on Energy Policy (NCEP)	Think Tank
	Pew Center for Global Climate Change (Pew)	Environment
Prudents	Environmental Defense-NY	Environment
	The Nature Conservancy (TNC)	Environment
	Stockholm Environmental Institute (SEI)	Think Tank
	Union of Concerned Scientists (UCS)	Environment
	US Climate Action Network (USCAN)	Environment
Reluctants	EcoEquity (EE)	Environmental Justice
	Environment California	Environment
	World Wildlife Fund (WWF)	Environment
	Redefining Progress (RP)	Environmental Justice
Opponents	Sierra Club (SC)	Environment
	Greenpeace	Environment
	Communities for a Better Environment (CBE)	Environmental Justice

geologic sequestration with language such as ‘enthusiastic’ or ‘favorable towards’⁶. Negatively inclined interviewees described it as ‘terrible’ or ‘not a good thing’. Organizations were classified as neutral if no explicit positive or negative language was used to describe the technology, e.g.: ‘it is not a question of whether I like it or do not like it, but that we need it’.

Further examination of the data revealed the second axis of the typology—necessary and unnecessary. Throughout the interviews, the interviewees expressed whether they believed geologic sequestration were necessary and why they believed so. For example, one respondent viewed geologic sequestration positively and thought it to be necessary: ‘we see carbon sequestration as an important technology that should be developed further, and further utilized’.

From our typology in figure 1, we classified the NGOs into four categories: the *Enthusiasts*, the *Prudents*, the *Reluctants*, and the *Opponents*. Interviewees from NGOs who viewed geologic sequestration positively and necessary are the *Enthusiasts*. Interviewees who were neutral towards the technology but considered it necessary are the *Prudents*. The development of the typology yielded an interesting category, the *Reluctants*, who viewed the technology negatively but suggested that it was necessary. For example, one of these respondents stated, ‘I have a slogan that I repeat to anyone who asks me, which is, it is a terrible idea that we desperately need’. Other mitigation solutions such as renewable energy or energy efficiency, however, should be given more emphasis than sequestration. The fourth group comprised the *Opponents* who viewed geologic sequestration negatively and thought it was unnecessary. Two of the cells in figure 1 are empty; no one interviewed viewed the technology positively or neutrally and thought it unnecessary.

⁶ See table 1 for NGO abbreviations.

It is, of course, possible that the positions of the organizations whose representatives we interviewed will change as geologic sequestration policy unfolds in the US. It is also the case that NGOs are not monoliths and that multiple viewpoints exist within them. This is especially likely to be the case for geologic sequestration, on which people’s positions have yet to solidify. Internal differences notwithstanding, NGOs frequently take public positions *as organizations* on several environmental issues. Our interviewees themselves regularly used ‘we’ rather than ‘I’ when responding to questions. Table 1 provides an overview of the category under which each NGO currently falls, based on our interviews and on our analysis of its documented positions (if any) on climate change mitigation.

3. Findings

In this section we report our respondents’ opinions on the necessity of geologic sequestration, on what the risks are of this technology, and on whether and how their NGOs planned to shape public opinion on this topic. We present their views as they expressed them, without comment on the extent to which they agree or disagree with mainstream scientific opinions on specific topics. For every theme discussed below, we present only those views that were representative of at least two-thirds of each subgroup (Enthusiast, Prudent, Reluctant, and Opponents).

3.1. Views on climate change

Our findings confirm that climate change is a top environmental concern for the NGOs, a typical example being an interviewee who ‘realized the huge impact that climate change has on our mission’. These NGOs are actively seeking climate change

mitigation solutions. For some, the most feasible mitigation solution is CCS. An Enthusiast respondent argued that ‘in the past five years CCS has suddenly become so mainstream (amongst NGOs); almost partly because of the fact nothing else seems to have been able to address the problem (of climate change)’.

3.2. Necessity of geologic sequestration

All the interviewees from Enthusiast, Prudent and Reluctant NGOs viewed CCS as a necessary mitigation solution. The primary reason was the global reliance on fossil-fuel-based sources of power, especially coal, which they expected would continue. The dominant view was that the development and implementation of this technology should be the responsibility of developed countries such as the US. Although climate change would have adverse impacts in developing countries (IPCC 2007), these interviewees argued that the probability of independent mitigation by these countries was low because of immediate and pressing concerns such as healthcare or education. They also expressed concern that weak research and institutional capacities in these countries would hinder the successful implementation of geologic sequestration. In addition, they argued that the favorable political environment for geologic sequestration in the US made it a feasible mitigation solution. Examples were given of recent legislative activity on it by some states (i.e. Texas HB 149) and an increased interest in energy independence (reduction of fossil fuel imports) within the US. On the whole, Prudents were more insistent than Enthusiast NGOs that other solutions, such as renewable energy or energy efficiency, deserve the same amount of attention as geologic sequestration. Reluctant NGO interviewees, however, expressed reservations even while accepting the (temporary) necessity of the technology: ‘CCS ... is about winning time ... it is about mitigating climate change but it is not something that is sustainable for the long-term’.

Interviewees from Opponent NGOs disagreed with the others and did not accept CCS as a mitigation solution because they favored solutions such as renewable energy and increased energy efficiency. These interviewees were wary of the long history between the fossil fuel industry and geologic sequestration, given that it was originally developed for enhanced oil recovery (EOR) operations (Bondor 1992). They expressed concern that the fossil fuel industry may use geologic sequestration to continue with EOR, thereby allowing the continued use of an unsustainable energy infrastructure. Finally, they argued that the technology is itself unsustainable because the space in which to put CO₂ may eventually run out.

3.3. Risks of geologic sequestration

In the opinion of all the NGO interviewees, a major obstacle to the development and implementation of geologic sequestration was economic uncertainty. They suggested that there were unanswered questions about the capital and maintenance costs of large-scale geologic sequestration, as well as a ‘yawning set of unanswered questions in the regulatory and institutional framework that would govern how the technology entered the market’. These questions about costs and regulation could

make investment in geologic sequestration unattractive for private firms⁷. Another obstacle facing geologic sequestration was technological uncertainty. Technological concerns included whether enough was known about the hydro-geologic characteristics of potential sequestration sites to ensure its safety and success. Everyone also agreed that ‘rigorous studies and examples’ were needed to understand monitoring and verification techniques as well as site characteristics. A third obstacle was uncertainty with respect to social equity. Many argued that land use would be a major issue with the public and could prevent the implementation of geologic sequestration. Opponent interviewees in particular suggested that the technology would likely be located in poor areas: ‘many low-income communities of color do not have that kind of clout (economic or political); they are much more vulnerable to being the home for the sequestered CO₂’.

3.4. Policy framework for geologic sequestration

Opinions differed on what policy framework would be the most effective for the development and implementation of geologic sequestration. The Enthusiast and Prudent interviewees viewed a cap-and-trade system as the most efficient and effective policy structure. The Reluctant and Opponent interviewees favored a mandatory cap on GHG because it would be difficult to develop a cap-and-trade system that ‘is not full of holes’. They expressed concern that a cap-and-trade system would allow ‘polluters to continue to pollute’ and would not provide incentives to shift away from fossil-based forms of energy. Although there is no national US regulatory framework for geologic sequestration, all of the interviewees agreed that it should be federally regulated. They suggested, albeit with some reservations, that the Environmental Protection Agency should regulate it because ‘it has the legislative history, the authority, and the expertise to do it’.

3.5. Paying for geologic sequestration

Most interviewees agreed that the research, development, and implementation of geologic sequestration should be paid for through a federal tax. Opponent interviewees argued that since the mitigation of climate change was a public good the costs should be borne widely, whereas the Reluctants argued that a carbon tax on industry might be more appropriate. Most conceded, however, that the consumer would end up paying for geologic sequestration: ‘although the polluters should pay in practice, I think we all know they essentially pass on all of those costs and it is essentially passed onto the consumer prices’. Reluctant interviewees also argued that US consumers would bear the costs of the technology in the developing world: ‘basically, you know Americans and Europeans are going to pay to bury carbon in China and India and everywhere else’.

⁷ A key objective of the Texas bill and similar legislation is to relieve private firms of these uncertainties by transferring any long-term liability to the (state) government.

Table 2. Summary of views on geologic sequestration education efforts for the public.

	Example of views on public education	How?	When?	Desired outcome
Enthusiast	‘The most important element in the success of this technology is a huge education effort with everybody, the public, the media, academia’	Reports, public venues, websites, press, curricula in schools, public in scientific journal	Now or near-term	Immediate acceptance
Prudent	‘There does need to be a political discussion that involves the public and brings in the stakeholders’	Reports, public venues, websites, press, public in scientific journals	Long-term	Increased dialog on all fronts possibly with acceptance
Reluctant	‘(CCS) is something like disaster relief, you cannot win hearts and minds with CCS, you can only appeal to some rational acceptance’	Reports, public venues, websites, press, publish in scientific journals	No plans	Multi-pronged strategy with equal or more emphasis on other methods but including acceptance
Opponent	‘If we ever reach out to our membership it is to tell them to contact policymakers to tell them not to do this’	Reports, public venues, websites, press, publish in scientific journals	No plans	Rejection

3.6. Public perceptions

All of the NGO interviewees viewed positive perceptions of geologic sequestration by the public as important to its success, because ‘as we have seen, (negative perceptions) can be enough to kill’ a technology. Most interviewees suggested that the public’s knowledge of the technology was low or non-existent. With greater awareness, however, people could be worried about impacts on human health: ‘they will be worried about their kids playing in some abandoned lot that is suddenly flooded with CO₂’. They could oppose the technology ‘for the same reasons that people have been opposed to nuclear for years’, because of its similarities to large-scale technologies such as nuclear power; or, since geologic sequestration could take place at fossil fuel burning sources, especially coal, people may be concerned with the environmental impacts of coal mining. Finally, echoing the NGOs’ own concerns, a segment of the public may be concerned with social equity issues arising from the location of potential sites.

3.7. Public education

All the interviewees argued that educational efforts should be carried out by NGOs rather than by organizations they feel are deemed not ‘credible’ in the eyes of the public. As stated by an Enthusiast interviewee: ‘it would be the big NGO community and the research community with the most standing in the public’s eyes, you know, accurate and objective information’. In this view, ‘the public does not really trust the government even, I mean clearly they would not trust big coal companies or oil companies’. Each NGO category expressed different opinions of when the educational effort should begin and how it should be structured (see table 2). Only the Enthusiasts planned to present CCS as a climate change mitigation solution to the public in the near-term, where it would be part of the ‘whole toolbox that we present to combat global warming’.

3.8. Industry perspective

The Enthusiast, Reluctant, and Opponent NGO interviewees suggested that the fossil fuel industry would look upon geologic sequestration favorably, perhaps as an offset (compensating for emissions in one location by reducing or capturing emissions elsewhere) or under an emissions cap. Some interviewees argued that oil companies might actually gain from geologic sequestration. Industries with large stationary sources of emissions would likely pay for geologic storage, creating business opportunities that the oil industry is very well positioned to take advantage of. Finally, the Enthusiast interviewees suggested that the development of the technology may foster competition between companies: ‘you are going to have pulverized coal technology fighting with the gasification technology manufacturers about who can do it (geologic sequestration)’. This type of competition could fuel innovation and eventually lower the costs of the technology.

4. Interpretation of findings

In order to understand why particular NGOs occupied particular cells in our typology (see figure 1), we classified the NGOs along two dimensions—their histories of activism and their sources of funding. Our research results, while they cannot establish causation, do suggest a correlation between an NGO’s position and strategies regarding geologic sequestration, and its history of activism and sources of funding.

Histories of activism can broadly be distinguished by two strategies: cooperative bargaining or contentious politics (Conca 2007). Cooperative bargaining means a strategy in which the NGO negotiates with other actors such as government and private firms to reach consensus on how to manage an environmental problem. An example of an

NGO that uses predominantly cooperative bargaining is the NRDC, which worked with California businesses and state government officials to reach an agreement on the text of Assembly Bill 32 in 2006 (the Global Warming Solutions Act of 2006). Contentious politics can be defined by outside-the-institution strategies, which may include direct action or even disruptive techniques such as public demonstrations or civil disobedience to make a political point or to change environmental policy (Conca 2007). An NGO that uses contentious politics is Greenpeace, whose strategy in their historic anti-nuclear campaign of 1971 was to sail a group of protesters to a nuclear testing facility at Amchitka, off the coast of west Alaska.

NGOs receive funding from four main sources: governments (national, international or multilateral), private firms, foundations and private individuals. Through a review of publicly available tax forms (Form 990), NGO publications such as Annual Reports, and our interviews, we determined each NGO's most significant sources of funding, as defined by its top ten donors. For example, in response to questions about funding, the SEI representative said 'funders range from government institutions, like the US EPA, US DOE, other governments like the Dutch government, Swedish government, multilateral organizations like UN Environment Program, UN Development Program, (and the) World Bank'. The correlation between funding source and NGO advocacy strategies is likely to be one of feedback rather than of simple causation—NGOs' strategies may be influenced by, and may themselves influence, the sources of funding that they receive (Fisher 1997, Fox and Brown 2000). By tracing NGO histories of activism and sources of funding, we now explain why some NGOs favor geologic sequestration while others do not.

4.1. *Enthusiasts*

The Enthusiast NGO history of activism reveals a dominant strategy of cooperative bargaining with businesses, policymakers, and other stakeholders on environmental problems. A review of 990 tax forms and NGO Annual Report publications shows that most of their top ten donors are foundations and private firms, including in some cases the fossil fuel and utilities industry. These characteristics enable the Enthusiasts to work collaboratively with a range of actors on climate change, the outcome of which is the endorsement of climate change mitigation solutions that all involved can accept (in this case, CCS with geologic sequestration).

4.2. *Prudents*

The Prudent NGO history of activism shows that their strategies on environmental problems are also those of cooperative bargaining. In addition, several of these interviewees presented their organizations' primary role as that of the objective scientist for whom multi-stakeholder dialog was essential. The Prudents actively participate in the same forums as do the Enthusiasts, and provide their information directly to their funders and collaborators rather than to the public. The Prudents receive a significant portion of their funding through governments and the multilaterals, but also

foundations and private firms. These characteristics enable Prudent NGOs to investigate and propose a number of different solutions to mitigate climate change, only one of those being geologic sequestration.

4.3. *Reluctants*

The Reluctant NGO history of activism shows that their strategies include cooperative bargaining as well as contentious politics. For instance, WWF's strategies include organizing community groups among others to manage environmental problems (as in the debt-for-nature swap program in Ecuador). In the past, WWF has also used contentious politics to champion the rights of indigenous peoples in struggles over land management (e.g., in the Amazon). The Reluctant NGOs receive a significant portion of their funding from foundations and governments, but not from corporations.

4.4. *Opponents*

The Opponent NGO history of activism reveals a dominant strategy of extra-institutional and contentious politics on environmental problems. As described above, NGOs such as Greenpeace define their advocacy strategy as 'non-violent direct action'. The Opponents are mainly membership-based, with a significant portion, if not all, of their funding coming from foundations and private individuals. All of these characteristics leave Opponent NGOs free to reject consensus mitigation solutions such as CCS in favor of fossil-free alternatives such as energy efficiency or renewables. For example, the Sierra Club interviewee said, 'right now we have the choice between the clean stuff and the dirty stuff'. It seems likely that the Opponents will always choose the 'clean stuff'.

In 1982, Douglas and Wildavsky proposed a sociocultural analysis of environmental organizations in which they classified the social structure of NGOs as either hierarchical or sectarian. They argued that hierarchical NGOs, by which they meant centrally-organized groups with clear chains of authority, would generally value social stability, and would collaborate with mainstream social and political institutions to mitigate environmental harms. Sectarian organizations, which are more flexibly organized and significantly volunteer-dependent, typically stand at the 'border' (Douglas and Wildavsky 1982: p 174) of mainstream society. They would generally have less faith in established institutions, and so would favor extra-institutional strategies such as direct action in order to rescue the environment. Despite the many limitations of their analysis of the environmental movement (Winner 1982, Abel 1985, Tulloch and Lupton 2003), Douglas and Wildavsky's sociocultural perspective remains influential (see e.g., Rayner 1992, Thompson *et al* 1999). In our sample of 19 NGOs, we do find the correlation between NGO social structure and strategy to be loosely corroborated. Some of the NGOs are more hybrid in structure than the overly rigid hierarchical-versus-sectarian would imply. Overall, however, Enthusiast and Prudent NGOs do tend to be more centrally organized while Reluctants and Opponents are more loosely structured, often with semi-autonomous local chapters.

5. Conclusions and preliminary hypotheses

Our interview findings show that, in the US, three NGO categories favor acceptance of geologic sequestration: immediate acceptance (Enthusiasts), increased dialog on all fronts possibly with acceptance (Prudents), equal or more emphasis on other methods but including acceptance of geologic sequestration (Reluctants). Only the Opponent group favors rejection. Existing research on public perceptions of geologic sequestration shows that the public is largely unaware of the technology, and, when made aware of it, is neutral to negative about it (Sharp 2000, Curry 2004, Uno *et al* 2004, Palmgren *et al* 2004).

Our findings do not indicate whether any NGOs will eventually have much impact on the public's view of geologic sequestration, but we suspect that their effectiveness may be limited. Despite the universal agreement that the public should be educated about geologic sequestration, and educated by 'credible' NGOs, only the Enthusiasts plan to engage in public education in the near-term. Industry-supported NGOs have already started advertising campaigns to convince the public that geologic sequestration is essential, but they may not be considered as impartial as the traditional public-interest NGOs (Siegrist and Cvetovich 2000). Furthermore, the history of Enthusiast activism suggests that policy makers in government and business are more often the targets of their science and advocacy than is the general public, so it is unclear how effective they can be in influencing public opinion directly. On the other hand, the Reluctants *do* have a history of direct public engagement, but they are only lukewarm about geologic sequestration and will place equal or more emphasis on other approaches to climate change.

Our interviews indicate that while most Enthusiast, Prudent and Reluctant NGOs plan to actively advocate for CCS, or at least include this technology in their mitigation portfolios, there are fewer who plan to support nuclear power and terrestrial sequestration as mitigation options. Most NGOs see CCS as a superior option to nuclear power. However, one Reluctant NGO interviewee explained his position thus: 'the issue of how we get energy in a carbon constrained world does not allow us the luxury of demonizing anything'. For different reasons, this stance holds true for terrestrial sequestration vis-à-vis geologic. Geologic sequestration was uniformly seen as a better storage technology because of concerns that forested land used for terrestrial sequestration may not permanently remain forested ('how permanent is permanent? I mean you know, Vermont 50 years ago was 20% forested and now it is 70% forested, but it could easily be 20% forested again'). Nearly all of the NGOs agreed that renewables and energy efficiency must be part of a comprehensive mitigation portfolio, and perhaps as superior to CCS. The Enthusiasts, however, seemed more prepared to present CCS as a mitigation solution that was on par with the other two, because 'you need to throw everything at it (climate change)', and because 'CCS was designed to deal with the coal issue' in a way that renewable energy and energy efficiency are not.

Our review of the interviews and dimensions analysis (history of activism and sources of funding) allows us to

hypothesize how other US NGOs not interviewed for this paper might view CCS with geologic sequestration. This technology was in general seen by all but the Opponents as a bridging technology towards a less coal-dependent economy. The perception that geologic sequestration was necessary was driven largely by the beliefs that the technology was already viable, and that the use of coal would continue for some time because a significant reduction in coal was politically infeasible. Our findings indicate that US NGOs that use predominantly cooperative bargaining strategies to manage environmental problems, and receive a significant portion of their funding from governments or private firms, are likely to endorse emissions reductions through a range of technical solutions. Solutions that seem politically viable, such as CCS or cap-and-trade systems, are especially likely to be supported. NGOs that use contentious or extra-institutional politics to address environmental problems, and receive most of their funding from members and other private sources, are likely to pay less attention to political feasibility and to view geologic sequestration negatively. They will prefer 'the clean stuff' and mandatory emissions caps. Overall it seems that the majority of US environmental NGOs will accept CCS with geologic sequestration as a mitigation solution, while only a small fraction will not.

Acknowledgments

We thank Elizabeth Wilson and especially Sarah Wade for their comments and suggestions on earlier drafts of this paper. We also report, with great sadness, the tragic passing of our colleague and co-author, Alex Farrell, in April 2008. We miss him greatly, and will continue to do so as this project progresses. This paper is dedicated to his memory.

—IR and GWP

References

- Abel R L 1985 Blaming victims *Law Soc. Inq.* **10** 401–17
- Bewley T 2002 Interviews as a valid empirical tool in economics *J. Socio-econom.* **31** 343–53
- Bondor P L 1992 Applications of carbon dioxide in enhanced oil recovery *Energy Conserv. Manag.* **33** 579–86
- Carbon Sequestration Home Page 2008 *US Department of Energy: Office of Fossil Energy* Accessed 28 May 2008 <http://www.fossil.energy.gov/programs/sequestration/index.html>
- Cohen R E 1995 *Washington at Work: Back Rooms and Clean Air* (Needham Heights, MA: Macmillan)
- Conca K 2007 Environmental governance after Johannesburg: from stalled legalization to environmental human rights? *J. Int. Law Int. Relat.* **1** 121–38
- Curry T E 2004 Public awareness of carbon capture and storage: a survey of attitudes toward climate change mitigation *MA Thesis* Massachusetts Institute of Technology
- Douglas M and Wildavsky A 1983 *Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers* (Berkeley: University of California Press)
- Fisher W F 1997 Doing good? the politics and antipolitics of NGO practices *Annu. Rev. Anthropol.* **26** 439–64
- Fox J A and Brown L D 2000 *The Struggle for Accountability: The World Bank, NGOs, and Grassroots Movements* (Cambridge, MA: MIT Press)

- IPCC 2005 Summary for policymakers *Carbon Dioxide Capture and Storage. A Special Report of Working Group III of the Intergovernmental Panel on Climate Change* ed B Metz, O Davidson, H de Coninck, M Loos and L Meyer (Cambridge: Cambridge University Press)
- IPCC 2007 Summary for policymakers *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* ed M L Parry, O F Canziani, J P Palutikof, P J van der Linden and C E Hanson (Cambridge: Cambridge University Press) pp 7–22
- Jepson P 2005 Governance and accountability of environmental NGOs *Environ. Sci. Policy* **8** 515–24
- Johnson B B 1987 Public concerns and the public role in siting nuclear and chemical waste facilities *Environ. Manag.* **11** 571–86
- Mishler E G 1986 *Research Interviewing* (Cambridge, MA: Harvard University Press)
- McDonald C 2007 House energy committee unanimously approves *FutureGen Legislation: 2007 Session's FutureGen Legislation is Texas' Final Step in Preparing Strongest Bid Possible* 11 April 2007. The Railroad Commission of Texas. Accessed 15 October 2006
- Palmgren C R, Morgan M G, Bruin W B d and Keith D W 2004 Initial public perceptions of deep geological and oceanic disposal of carbon dioxide *Environ. Sci. Technol.* **38** 6441–50
- Parson E A and Keith D W 1998 Fossil fuels without CO₂ emissions *Science* **282** 1053–4
- Princen T and Finger M 1994 *Environmental NGOs in World Politics: Linking the Local and the Global* (London: Routledge)
- Public Outreach Homepage 2008 West coast regional carbon sequestration partnership Accessed 28 May 2008 <http://www.westcarb.org/outreach.htm>
- Rayner S 1992 Cultural theory and risk analysis *Social Theories of Risk* ed S Krimsky and D Golding (Westport, CT: Praeger) pp 83–116
- Richards L and Morse J M 2007 *README First for a User's Guide to Qualitative Methods* (Thousand Oaks, CA: Sage Publications)
- Rowe G and Frewer L J 2000 Public participation methods: a framework for evaluation *Sci. Technol. Human Values* **25** 3–29
- Sharp J D 2000 Public attitudes toward geologic disposal of carbon dioxide in Canada *MA Thesis* Queens University
- Siegrist M and Cvetovich G 2000 Perception of hazards: the role of social trust and knowledge *Risk Anal.* **20** 713–9
- Thompson M, Grendstad G and Selle P 1999 *Cultural Theory as Political Science* (London: Routledge)
- Tulloch J and Lupton D 2003 *Risk and Everyday Life* (London: Sage Publications)
- Uno M, Mori Y, Tokushige K and Furukawa A 2004 Exploration of public acceptance regarding CO₂ underground sequestration technologies *Proc. 7th Int. Conf. on Greenhouse Gas Control Technologies (Vancouver, Sept.)* pp 1–6
- Winner L 1982 Pollution as delusion New York Times on the Web 8 August 1982. Accessed 8 August 2007 <http://query.nytimes.com/gst/fullpage.html?res=9B01E7D81039F93BA3575B0A964948260&n=Top/Features/Books/Book&20Reviews>

NGO References

- Environmental Defense Homepage 2007 *Environmental Defense* Accessed on 28 April 2007 <http://www.environmentaldefense.org>
- Natural Resources Defense Council Homepage 2007 *Natural Resources Defense Council* Accessed on 28 April 2007 <http://www.nrdc.org.asp>
- The World Resources Institute Homepage 2007 *The World Resources Institute* Accessed on 28 April 2007 <http://www.wri.org/>
- National Commission on Energy Policy Homepage 2007 *National Commission on Energy Policy* Accessed on 28 April 2007 <http://www.energycommission.org>
- California Climate Action Registry Homepage 2007 *California Climate Action Registry* Accessed on 28 April 2007 <http://www.climateregistry.org>
- The Nature Conservancy Homepage 2007 *The Nature Conservancy* Accessed on 28 April 2007 <http://www.nature.org/>
- The Union of Concerned Scientists Homepage 2007 *The Union of Concerned Scientists* Accessed on 28 April 2007 <http://www.ucusa.org/>
- Environment California Homepage 2007 *Environment California* Accessed on 28 April 2007 <http://www.environmentcalifornia.org/>
- World Wildlife Fund Homepage 2007 *World Wildlife Fund* Accessed on 28 April 2007 <http://www.wwf.org/>
- PEW Center on Global Climate Change Homepage 2007 *PEW Center on Global Climate Change* Accessed on 28 April 2007 <http://www.pewclimate.org/>
- Sierra Club Homepage 2007 *Sierra Club* Accessed on 28 April 2007 <http://www.sierraclub.org/>
- Greenpeace USA Homepage 2007 *Greenpeace USA* Accessed on 28 April 2007 <http://www.greenpeace.org/>
- Communities for a Better Environment Homepage 2007 *Communities for a Better Environment* Accessed on 28 April 2007 <http://www.cbecal.org/>